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# AIR TRAFFIC GROWTH, AIRLINE FINANCES, AND PUBLIC BENEFITS IN RELATION TO THE COST OF NEW PROGRAMS TO ALLEVIATE JET AIRCRAFT NOISE NEAR AIRPORTS

Prepared for the

FEDERAL AVIATION AGENCY

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# I. SUMMARY AND CONCLUSIONS

## Purpose

Effective new programs for coping with aircraft noise problems around airports in the United States will probably involve new expenditures of public and private funds. Rational formulation of public policy requires that applicable economic facts and relationships be analyzed, stated, and applied to the problem of how to allocate such additional costs among producers of aircraft, airlines, other users of aircraft, airport operators, and the general public through Federal and other government agencies.

In order to accomplish this purpose, the analysis of three subjects was required: (A) the impact of price increases on traffic development, (B) the ability of the airlines to pay the additional costs without passing them on to their customers in the form of higher prices, and (C) how much, if any, of costs and benefits of air transportation should be assigned to the general public.

## A. IMPACT OF PRICE ON TRAFFIC

### 1. General Approach and Procedure

In estimating the impact of price on traffic davelopment, it was necessary to make forecasts of future traffic both with and without assuming the additional costs of airport noise programs would be paid for by travelers and shippers.

Critical review was therfore made of two analytical processes: the methodologies by which traffic forecasts are made, and the techniques by which the effect of price elasticity of demand is measured. These two are closely interrelated, since price is one of the key ingredients of valid forecasting.

There is a wide variety of traffic forecasting methods. These may be grouped into four major types: those that give specific weight to price elasticity of demand, those that make statistical trend projections at assumed prices, a theory of technological innovations that produce cycles of traffic growth, and the analysis and projection of "cells" of travelers by market characteristics. Unfortunately, all forecasting involves major difficulties, and it is not necessarily a criticism of the methods examined that we reached our conclusion that no one forecast, or combination of forecasting methodologies, has yet been able to identify and reduce to quantitative terms sufficient causal factors to give us a high degree of confidence in their validity. In addition, few forecasts seem able to identify, in advance, the kinds of major economic change that have produced marked discontinuities of growth trends in the past. The work done specifically on price elasticity of demand shows general agreement on broad aggregative totals, but individ market analyses show wide variations.

It will be noted that our comments on forecasting methodologies are largely negative on volumes of absolute traffic estimated by any method. This is partly inherent in an industry evolving at the extremely rapid pace of civil aviation which is unique in the economic history of the United States for a rate of growth so rapid, sustained for so long a time, and with so fast a rate of major technological change.

However, to help alleviate the consequent feeling of doubt in using our forecasts of traffic, it is also of greatest importance to emphasize that the purpose of our study is not primarily to forecast future traffic volumes in the absolute sense, but to measure the differential between what they would be with, and without, assumed price changes.

### 2. Domestic Trunk Passenger Traffic

Most of the forecasts and elasticity studies made to date have been for domestic trunk passengers. The most comprehensive, thorough, and appropriate in degree of statistical sophistication is the methodology developed by the CAB staff. Its formula is based on fares, income, time trend aggregating all other variables, price index, and population.

Although we believe that it is the best produced so far, we have several objections to some of it. One of its major ingredients is an assumed future level of fares as most likely; the CAB staff does not recommend any one of the three levels it calculates, and the one assumption of an absolute decline in present dollar fare level appears to be unrealistic as a statistical probability, since it projects a long-term trend downward from a unique peak to a unique trough in the past which has since been reversed. Another major problem area is its assumption of a straight-line relationship between income and traffic, since it seems more logical to assume a relationship between traffic and the increase in income left available for elective purchases after deducting probable expenditures for the necessities of life. Other statistical problem areas include combining a variety of factors in an all-inclusive trend variable, and the proper selection of a base period of years for projection.

Our final method of estimate was to use the CAB staff formula including its coefficient of price elasticity, but also doubling its coefficient of income elasticity.

### 3. International Passenger Traffic of U. S. Airlines

The best method developed appears to be that of Stephen Wheatcroft in his study of North Atlantic travel. His price elasticity of demand, when adjusted for the relative proportions of business and non-business travel, is almost precisely the same as that found by the CAB staff. His conclusion, however, was that the income effect on traffic was far greater than price. The rate of growth of international passenger travel has been higher than the domestic rate, and we project that it will continue to be higher in the future.

### 4. Domestic Cargo Traffic

The forecasting of cargo trends is a task involving the most uncertainty in air transportation. Although a large number of forecasts have been made in this area, they all face large inherent difficulties. One of these is the relatively short and uneven history on which to base future prognostications.

The other is the probably large effect of factors whose quantitative influences have not been measured -- greater reliability and frequency of service, and more concentrated selling efforts on the part of the carriers, in addition to the relation of cargo volume to rate changes. The method we finally chose is a double relationship: first, that of total intercity ton-miles as a percent of gross national product, and second, the penetration of air cargo into total cargo ton-miles on a Gompertz growth curve.

Cargo elasticity of demand is difficult to estimate, lacking studies in the subject. Opinions on it vary widely, although they are made without attempting to quantify it, and we have therefore presented estimates for elasticities of -1.5 and -2.0, with final estimates at the lower figure.

5. International Cargo Traffic of U. S. Airlines

Forecasting international cargo traffic involves the same problems as domestic projection, to which must be added the important effects of the diverse general economic trends in many foreign nations. The method of forecasting that we chose was a relationship of international to domestic cargo trends, paralleling that of the relationship of corresponding passenger trends.

6. Local Service Airlines

Local service airline passenger and cargo traffic have been increasing at a very rapid and consistent rate for more than a decade, with no signs yet of slowing down. We therefore projected a continuation of trends for the past decade into the next fifteen years.

7. General Aviation

The best study of general aviation fleet and operations is that of the FAA. Using their projections for 1975, we calculated the annual average rates of growth by type of general aviation flying, and applied them to interpolate to 1970 and extrapolate to 1980.

The price elasticity of demand has not been studied for general aviation. A key consideration in this, as in airline traffic, is the purpose of travel as between business and non-business. By 1980, business and commercial type aircraft will amount to almost one-third of the total number. They will fly over half of the total hours, include practically all of the turbine-powered aircraft in the general aviation fleet, and, with their much larger average size, account for the great bulk of passenger-miles and ton-miles flown. On this basis, it is likely that the price elasticity of general aviation operations as a whole will be very close to unity.

## 8. Foreign Airlines at U. S. Airports

The same basic factors affect the traffic and operations of foreign airlines at U. S. airports as affect U. S. international air carriers. In addition, the ratio of foreign-flag to U. S. carriers, of traffic in and out of the U. S., seems to have stabilized in the last few years at almost precisely a one-to-one relationship. We therefore estimate that foreign flag traffic will continue to move up at the same rate and in the same amounts as U. S. flag carrier traffic.

## 9. Summary of Airline Forecasts

The accompanying tables summarize all airline traffic as forecast, together with the changes in volumes estimated for rate increases of 1 and 5 percent. The first table, on page 7, shows SARC's basic forecasts of passenger traffic, reaching 268.8 billion revenue passenger-miles by 1980; if fares were increased by 1 percent, the traffic would be reduced by 1.3 percent, or 3.4 billion, to 265.4 billion; if fares were increased by 5 percent, traffic would drop by 6.3 percent, or 17.0 billion, to 251.8 billion. By 1980, estimated passenger revenues would be $15.5 billion; because the price elasticity of demand is moderate (-1.28 for domestic trunklines, -1.6 for international, and -1.0 for local service), revenues would change very little as compared to traffic volume, to $15.4 billion for a 1-percent fare cut and to $15.2 billion for a 5-percent reduction. Estimated cargo revenues for the same three rate assumptions f 1980 would be $5.4 billion, $5.3 billion, and $5.2 billion, wi price elasticity of demand for cargo at -1.5.

It is interesting to note that the traffic estimates of SARC are less than those of the FAA which were published in January 1967 and prepared for purposes other than the analysis here. The FAA forecasts are for fiscal years rather than cale dar years, and extend only to 1977. The table on page 8 shows the FAA forecasts together with our estimates of traffic losse assuming fare increases of 1 percent and 5 percent -- as an alternative to the SARC forecasts. It should also be noted that the total level of passenger traffic estimated by FAA (266.0 billion) to be achieved by fiscal 1977 is almost exactly that estimated by SARC for 1980 (268.8 billion).

However, it should again be emphasized that the main thru of our effort is not to forecast specific volumes of air traff but to measure the effects of a change of price on whatever the forecasts are. In doing so, our formula and figures for price elasticity of demand can be applied directly to 300 billion revenue passenger-miles, or to any other figure, to obtain the probable effect of adding the costs of airport nois programs to the prices charged by the airlines, and their consequent effect on the development of civil aviation.

## B. ABILITY OF AIRLINES TO PAY ADDITIONAL COSTS

A key question is whether, in view of recent high airline profits, the future financial ability of airlines will enable them to absorb any or all of the possible cost of noise contro programs, without raising their prices so as to pass on the additional expenses to their customers.

There are, of course, a number of other possible claimant for potential airline future profits -- labor increased user charges, interest rates, financing requirements, and inflation of the general economy requiring higher costs of purchases suc

## SARC TRAFFIC FORECASTS, AND AT 1 AND 5 PERCENT RATE INCREASES

| Item | 1955 | 1960 | 1965 | 1970 | 1975 | 1980 |
|---|---|---|---|---|---|---|
| TOTAL REVENUE PASSENGER-MILES (Billions, domestic and international) | | | | | | |
| Basic forecast | 24.2 | 38.8 | 69.5 | 112.0 | 176.4 | 268.8 |
| At 1% fare increase | | | | 110.5 | 174.2 | 265.4 |
| At 5% fare increase | | | | 104.8 | 165.2 | 251.8 |
| Differences from basic forecast | | | | | | |
| At 1% fare increase | | | | 1.5 | 2.2 | 3.4 |
| At 5% fare increase | | | | 7.2 | 11.2 | 17.0 |
| TOTAL CARGO REVENUE TON-MILES (Millions, domestic and international) | | | | | | |
| Basic forecast | 717 | 1,243 | 3,048 | 6,424 | 13,433 | 25,501 |
| At 1% rate increase | | | | 6,329 | 13,235 | 25,126 |
| At 5% rate increase | | | | 5,971 | 12,490 | 23,712 |
| Differences from basic forecast | | | | | | |
| At 1% rate increase | | | | 95 | 198 | 375 |
| At 5% rate increase | | | | 453 | 943 | 1,789 |

## FAA TRAFFIC FORECASTS, AND AT 1 AND 5 PERCENT RATE INCREASES

Billions of domestic and international revenue passenger-miles

| Item | 1955 | 1960 | FISCAL YEARS<br>1965 | 1970 | 1973 | 1977 |
|---|---|---|---|---|---|---|
| Basic forecast | 24.2 | 38.8 | 62.6 | 118.8 | 167.5 | 266.0 |
| At 1% fare increase | | | 61.8 | 117.3 | 165.3 | 262.6 |
| At 5% fare increase | | | 58.6 | 111.2 | 156.8 | 248.9 |
| Differences from basic forecast | | | | | | |
| At 1% fare increase | | | | 1.5 | 2.2 | 3.4 |
| At 5% fare increase | | | | 7.6 | 10.7 | 17.1 |

as fuel, goods, and services.

We have made a projection of the basic elements in airline revenues and expenses -- traffic, prices, types of new aircraft and timing of their acquisition and retirement of older models, capacity, gradual increase in load factors with increased traffic limited by ubiquitous multiple-carrier competition; elements of direct operating cost such as flight crews, fuel and oil, insurance, and maintenance; indirect operating costs such as passenger service, aircraft and traffic servicing, promotion and sales, and general and administrative; investment, and reasonable rate of return on investment as established by the CAB.

It should be noted that in this section of the report, unlike the previous section on traffic, we are not estimating the effects of possible rate changes on the airlines. Instead, we are forecasting the probable financial effects of future traffic and operations using an assumption of constant airline fares in terms of current dollars. It is in view of the estimated net profits on such basis that the decision would have to be made as to the possible ability of the airlines to absorb additional costs without raising their prices.

Summing up the results of all assumptions and detailed computations, a comparison of the net income and element of return on investment required for the domestic trunks, international carriers, and all-cargo services, is as follows:

| | (Million Dollars) | | | |
|---|---|---|---|---|
| | 1965 | 1970 | 1975 | 1980 |
| Gross Passenger and Cargo Revenues | $4,958[1] | $7,817 | $12,977 | $20,833 |
| Net Income | 460 | 803 | 1,096 | 1,315 |
| Return Element Required[2] | 356 | 782 | 977 | 1,481 |
| Excess (shortage) of Income | $ 104 | $ 21 | $ 119 | $ (166) |

(See next page for footnotes.)

1/ Includes $291 million for local service carriers.

2/ Rates of return considered to be reasonable by the CAB of 10.5% for domestic trunks; 5 3/4% on debt and 14% in equity for local service carriers, and 11% for U. S. international airlines.

The FAA forecast would by 1977 achieve almost exactly our estimated 1980 level of traffic. By 1980, the estimate of traffic, if continued at the same rate of growth, would exceed our 1980 traffic by 41 percent; with a slightly higher load factor, the financial results would be improved somewhat to overcome our estimated small percentage shortage of income necessary to provide a reasonable rate of return.

In addition, it is estimated that the subsidy needs of the local service carriers will decline from $65 million in 1965 to $47 million in 1970, to $23.5 million in 1975, and to $4.5 milli in 1980.

It seems likely that, unless airport noise program costs will be appreciable, as compared to all other expenses of the order of magnitude of gross revenues shown in the table above, their actual effect may well be blanketed by probable changes in other cost variables. From our estimates, it appears that there will be little if any margin of profit above a fair rate of return from which the airlines could pay additional costs of airport noise programs, as shown by the estimated net profits above of $21 million in 1970, $119 million in 1975, and a defici of $166 million in 1980. It is also likely that, in addition, if any surplus of profits were in fact to be achieved over a period of time, the CAB would use some of its many regulatory powers to limit the upper level of profit margins. We conclude, therefore, that the most likely source of revenues by which the airlines could pay for airport noise programs would be price increases to their customers. The future financial picture of the airlines appears to be comfortable to cover all expenses and a fair return on investment, but not sufficient to pay large additional expenses out of forecast revenues at forecast rate levels.

Note on the Effect of Added Costs on General Aviation

It seems likely that the effect on general aviation as a whole would be minimal. Only turbo-jets are of the type producing noise leading to possible airport noise programs. It is estimated that general aviation fleets will include only about 1,500 of these by 1975, with an average annual utilization of some 750 hours or approximately 400 landings per aircraft, on which airport charges could be levied.

## C. ALLOCATION OF COSTS TO PUBLIC BENEFITS

The argument is often made that there are economic, political, national defense, and other benefits to the general public from air transportation. The validity of such a position would justify a policy that some of the costs of programs to alleviate airport noise should be obtained from the general public by reducing user charges.

The only source of noise is the aircraft landing and taking off at airports, particularly the jets causing the acute noise problem. The direct beneficiaries of these aircraft operations are the users -- passengers, shippers, airmail, and general aviation. The primary indirect beneficiary is the entire national economy, through the advantages of more rapid transportation in facilitating work and travel. Other indirect beneficiaries are the airlines who might share in the benefits, some nearby property owners if their property value increases for industrial or commercial purposes, and localities which may be in competition with other localities for economic activity brought in to the community by air commerce; these indirect benefits are transfers from the traffic and therefore represent a phenomenon of the free market which requires no further economic transfers.

A number of other industries also produce by-product dis-benefits to the public in the course of their production processes. Pollution of air and water is an illustrative parallel, where a steel mill or oil refinery may dump its industrial wastes into rivers or the air; the cost of devices to reduce or purify these wastes is a matter of public policy as to whether the industry or the public in general is to pay. Air transportation should, as a matter of economic practice in the long run, receive the same treatment as is accorded other industries -- whatever that policy may be as developed in the future.

Similarly, a number of basic industries are of great importance to the national defense posture of our country. They are not generally granted subsidy, and payment is made to them only for specific output bought by the Government for use of its armed forces or for stockpiles. In civil aviation, the parallel seems clear -- for the Government to pay for the costs of current military flight operations on airways and at airports, but not to give special subsidy for general standby national defense readiness.

We have examined the literature of other Government agencies which supply resources for highway and waterway transportation. None of them has a specific economic rationale for allocating any proportion of transportation costs to the general public, although as a practical non-economic matter several of them subsidize some of the expenses of some modes of transportation.

In summary, it appears that the indirect economic benefits of air transportation should not be regarded by the Federal government any differently then those of other industries. This leaves, as the logical payers for air transportation benefits, the direct beneficiaries -- passengers and shippers -- through the pricing system of airlines and the costs of general aviation.

## II. INTRODUCTION

The purpose of this study is to help FAA formulate policy in dealing with some of the problems associated with the cost of new noise alleviation programs. Effective new programs for coping with aircraft noise around airports in the United States will probably involve new expenditures of public and private funds.

Rational formulation of public policy requires that, among other things, applicable economic facts and relationships be analyzed, stated, and applied to the problem of how to allocate such additional costs among producers of aircraft, airlines, other users of aircraft, airport operators, and the general public through Federal and other government agencies.

In order to accomplish this purpose, three analyses were required: first, the impact of price increases on traffic development, usually termed price elasticity of demand; second, the ability of the airlines to pay for the additional costs out of possible commercial profits without passing them on to their customers in the form of higher prices; and third, how much, if any, of the costs and benefits of air transportation should be assigned to the general public if economic rationale is used as a basis.

It is also well to define what this report is not supposed to accomplish. It does not deal with the physical or economic programs by which noise around airports is to be alleviated. It is not intended to tackle all the economic problems that may be associated with noise alleviation, other than the three stated above. And it is not designed to include criteria other than economic, such as political and broader social objectives, except those involved in evaluating general public benefits for which specific allocations should be made.

It will be noted that our analysis has been made in some detail by carrier group -- domestic trunklines, international and territorial, local service, and the all-cargo services of the domestic and international airlines. This has been done in an attempt to improve the forecasts, since each of these major carrier segments has quite different traffic and financial aspects, and it is believed that the sum of the group forecasts is more accurate than projecting an industry aggregate. It may also be useful, to the FAA in future work, to have the carrier groups sufficiently differentiated so as to be considered separately when desirable.

Although a considerable amount of research was performed on the methodologies used by various Federal transportation and wat resource agencies in assigning costs or benefits to the general public, the results proved to be negative. The detail of such research has therefore been omitted from this final report altho for other purposes, it may prove to be useful to FAA and was therefore supplied to them as appendix material in the first dra

It will also be noted that our analyses are stated in very specific and seemingly precise traffic and dollar amounts. Of course, in dealing with any estimates of the future, and depending upon a large number of unknowns under general conditions of a changing national economy, great precision is unrealistic. We could have presented our data in terms of ranges between a probable ceiling area and a probable floor. This would, however, have added a great deal of complexity to the report. Under such circumstances, most readers use an average or median of values presented, and so they would as a practical matter probably end up with the same figures we have shown.

It appears that there is a very large and long-term problem facing the nation in the area of aircraft noise alleviation. Thi study should be considered as a specific part of a much larger an longer effort, with its boundaries limited as stated above.

## III. IMPACT OF PRICE ON TRAFFIC

### A. GENERAL APPROACH AND PROCEDURE

The overall approach used was, first, to make reasonable forecasts of future traffic without assuming any additional costs of airport noise programs, and second, to make comparable forecasts reflecting the probable impact if the price to the customer includes assumed levels of added cost.

Since at this time we do not know the probable costs of airport noise programs, we are making the forecasts on the basis of alternatively adding one and five percent to the air transport costs and consequent prices charged. One percent of gross airline revenues would be of the order of almost $80 million in 1970 and over $200 million in 1980; five percent would be almost $400 million in 1970 and over a billion dollars by 1980. Any specific figure within this range, as may later be estimated on the basis of more specific airport noise programs, can be linearly interpolated.

The time span into the future for the forecasts is fifteen years, by five-year intervals from 1965, the last full year for which data are available, to 1970, 1975, and 1980.

The relative importance of certificated airline operations in 1965 revenue ton-miles and dollar revenues is:

| | Percent of 1965 - | |
|---|---|---|
| Airline Group | Revenue Ton-Miles | Dollar Revenues |
| Domestic: | | |
| Trunk | 60.5% | 67.0% |
| Local Service | 2.8 | 4.6 |
| All-Cargo | 4.7 | 1.7 |
| Other (Helicopter, Intra-Alaska, Intra-Hawaii) | .4 | .9 |
| Sub-total, Domestic | 68.4 | 74.2 |
| International & Territorial: | | |
| Passenger/Cargo | 28.9 | 24.8 |
| All-Cargo | 2.7 | 1.0 |
| Sub-total, International & Territorial | 31.6 | 25.8 |
| Total, Certificated Route Carriers | 100.0% | 100.0% |

In addition, forecasts were made for two groups outside the U.S. certificated route carriers -- the operations of foreign flag carriers as they affect operations at U.S. airports, and U.S. general aviation. Traffic of U.S. supplemental carriers is included with the route carriers as noted subsequently.

The types of traffic carried in 1965 by U.S. certificated route carriers were:

| Type of Traffic | Percent of 1965 - Revenue Ton-Miles | Percent of 1965 - Dollar Revenues |
|---|---|---|
| Passengers | 71.7% | 85.9% |
| Freight | 22.0 | 9.1 |
| Express | .9 | .7 |
| U.S. and Foreign Mail | 5.0 | 3.6 |
| Excess Baggage and Other | .4 | .7 |
| Total, Certificated Route Carriers | 100.0% | 100.0% |

For passenger traffic, the primary volume measurement is revenue passenger-miles. For freight traffic, the primary index is revenue ton-miles; all-cargo aircraft are separated from combination passenger-cargo planes in both the traffic and the fleet figures.

The future composition of aircraft fleets is estimated for the airlines as between jets and other types, and within the jets for four-engine as compared to three- and two-engine aircraft; the general aviation fleet is projected for jets as compared to all other.

All forecasting involves major difficulties, as is well known to those who engage in it. An examination of the many existing major air traffic forecasts only serves to emphasize the problems. It is our conclusion that no one forecast, or combination of forecast methodologies, has yet been able to identify and reduce to quantitative terms sufficient causal factors to give us a high degree of confidence in their validity. In addition, few forecasts concentrate on identifying in advance the kinds of major economic change that have produced marked discontinuities of trends in the past, and few give us the feeling that they can foresee the timing, direction and degree of major discontinuities in the future.

This is not meant as a criticism of any specific forecasts. It is quite possible that the very nature of forecasting -- of trying to imagine and particularly to specify and quantify major events into the more distant future -- cannot overcome the necessary drawbacks of assuming even a modified statistical projection of past history.

In particular, relatively few studies have been made on price elasticity of demand in such manner as to give us a feeling of confidence in their validity for future application, and such work as has been done is generally only for the broadest of aggregative totals. This factor is closely linked with problems of forecasting, since valid forecasting requires that all major factors, including price effects, be taken into account.

Price elasticity of demand is a key concept in these analyses. It is a measure of the responsiveness of volume of air travel to changes in fare levels.

Unit elasticity is defined as the percentage change in volume accompanying a change in price just sufficient to produce the same gross revenue. An elastic demand is where volume increases more than this amount, and an inelastic demand is where volume increases less.

A common misunderstanding of elasticity is based on the erroneous idea that if a price changes by a specific percentage, and if the volume changes by the same percentage but in the opposite direction, the market is elastic. This is not so. For example, suppose there is a travel market where, before the fare change, 100 passengers moved at a fare of $100 each, producing a gross revenue of $10,000. If the fare is then reduced 20 percent to $80, and number of passengers also increases 20 percent to 120, the gross revenues are $9,600, and the market is therefore inelastic. To be elastic, the volume of traffic would have to exceed a 25 percent increase in traffic to 125 passengers, which would produce a gross revenue the same as before the price change, $10,000.

The derivation of elasticity effects through mathematical formulas, and a table of the traffic effects of various price elasticities used in this report, for fare increases of 1, 2, 3, 4, and 5 percent, are given in Appendix 1.

## B. DOMESTIC TRUNK PASSENGER TRAFFIC

By far the most important segment of all U. S. certificated route air carrier traffic and revenues in the U. S. is accounted for by domestic trunklines -- 65 percent of total ton-miles and 67 percent of total revenues in 1965. Among the trunklines, the highest concentration of traffic and revenues is in passengers, who accounted for 80 percent of these airlines' ton-miles and 90 percent of their revenues.

Because the domestic trunklines are the most important group from the point of view of traffic and revenues, and because most of the intensive research in price elasticity has been for this group, the basic methodologies and the quantitative answers produced in trunkline analyses will weigh heavily in analyzing the other groups.

### 1. Forecast Methodologies

We have examined a large number of forecasts and their underlying methodologies (See Appendix 2.). A few of them attempt to measure price elasticity of demand; most do not do so, but project trends at assumed prices. Of those trying to measure price elasticity, Turner found a U. S. price elasticity of -1.15 compared to an income elasticity (the effect of consumer income on traffic) of 1.67; Wallace found that in the top 40 U. S. markets the reasons for air traffic growth were almost evenly divided between price elasticity, air service improvements, and income elasticity; and Bjorkman found a wide range of price elasticities in non-U. S. markets from -.7 to -3.4 with a median in his illustrations of -1.9.

## 2. CAB Staff Methodology[1]

The methodology developed by the CAB staff is, in our opinion, the most comprehensive, thorough, and appropriate in its degree of statistical sophistication. Although we believe that it is subject to some objections (see Appendix 3), on balance it still remains the best in the field to date.

After examining a large number of factors with possible effects on domestic trunkline air traffic forecasts, the CAB staff finally selected a formula based on fares, income, time trend aggregating all other variables, price index, and population.

These appear to be among the most important factors influencing air passenger traffic, and the basic approach appears to be sound. There are, however, a number of difficulties encountered in reducing the basic factors to specific figures.

One of the major problems is that of selecting a reasonable assumed future fare level. The CAB staff assumed three fare levels: Forecast A, that fares will remain constant in terms of real purchasing power; Forecast B, that fares will remain constant in terms of dollars and therefore falling slightly as the price index increases; and Forecast C, that fares will decline by 1.14 percent per year. Our objections to this latter are detailed in Appendix 3.

Another major problem is the probable relationship between airline passenger traffic and the income index used by the CAB staff (disposable personal income per capita). Our objection is to the formula whereby these two are related as a direct straight-line variation in their rates of change. We feel that a relatively fixed amount of income per capita is required for primary necessities, and that the dollar volume available for air travel and other elective purchases therefore rises at a much more rapid rate than the aggregate of such income.

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[1] U.S. Civil Aeronautics Board, Bureau of Accounts and Statistics, Research and Statistics Division. Forecasts of Passenger Traffic of the Domestic Trunk Air Carriers, Domestic Operations, Scheduled Service, 1965-1975. September 1965.

Several other problem areas may well be somewhat outside the ability of the CAB staff or any other group to solve objectively and statistically. These are the lumping together of a variety of factors in an all-inclusive trend variable which the CAB staff recognizes and properly attributes to lack of sufficient basic data; to proper selection of a base period for projection; and to a reluctance based on economic criteria on the part of airlines to reduce fares even if there is the amount of elasticity of demand as estimated by the CAB staff formula.

### 3. Composite Forecast

The CAB staff estimated a price elasticity for domestic trunk air passengers of -1.28 and an income elasticity of 1.16. As will be discussed in Section C below, Wheatcroft's study of North Atlantic travel concluded that the price elasticity of that market was -1.6 for summer travel, but that its income elasticity was much higher at 2.3.

The CAB and Wheatcroft price elasticity figures are practically identical when allowance is made for the relative composition of business and non-business passengers in the two markets. Wheatcroft found that the price elasticity of business travel was in a broad area between -.4 and -1.0, and for recreational travel it was between -2.0 and -2.1. The relative weighting by purpose of travel produced the -1.6 in the North Atlantic. If it is assumed that his approximate price elasticity figures were -.9 for business travel and -2.0 for non-business, then domestic travel, with approximately two-thirds business and one-third personal, would have a resultant net elasticity of -1.27, which is almost precisely that estimated by the CAB staff.

There is much more divergence of findings when we try to reconcile the measured effects of income on air travel. The CAB staff found that income elasticity was only 1.16, just half of Wheatcroft's 2.3, and Turner's figure was about halfway between, at 1.67 (compared to his measure of domestic price elasticity of -1.15).

As mentioned earlier (and in more detail in Appendix 3), we do not believe that there is a straight-line relationship between rates of growth of disposable income and air travel. We believe that air traffic will increase much more rapidly as per-capita income rises, and that this factor will therefore be of increasingly greater importance with the expected continuing growth of incomes. Although we are convinced that this is true, the limitations of time and effort in our present study preclude working out a logical and accurate mathematical relationship. For practical purposes, therefore, and as only a rough approximation to what may be developed by additional research work, we agree that, as a long-term trend, the income elasticity will be at the higher figure found by Wheatcroft.

This produces another statistical difficulty. The CAB staff method of multiple regression would result in greatly changed values for all its interrelated coefficients if the value of any one were to be changed. If their figure for income elasticity is assumed to be too low, then it is most likely that their estimate of price elasticity is correspondingly too high.

However, as noted above in converting Wheatcroft's findings to domestic application, the ratio of non-business to business travel is crucial in the overall price elasticity figure. It is generally agreed that in the long run the greatest potential for traffic growth is primarily in the pleasure/personal/vacation field. With the probable more rapid rate of growth of this type of travel in the future, and the consequent increasing weight of its higher price elasticity in the total measurement, it seems likely that the possible overstatement of present price elasticity by the CAB staff method may well be overtaken by the non-business trend.

For the purpose of forecasting probable levels of domestic passenger traffic over the next fifteen years, therefore, we will make the assumption that income elasticity will approximate in the aggregate the linear income relationship of Wheatcroft's higher estimate, combined with the price elasticity found in the CAB staff formula. On this basis, then, we adjust the CAB Forecast B upward by an additional amount for doubling the effect of income, and arrive at the following estimates:

### DOMESTIC TRUNK PASSENGER TRAFFIC

| Year | Revenue Passenger-Miles (billions) | Annual Rate of Growth 5-Year Period |
|---|---|---|
| 1955 | 19.2 | |
| 1960 | 29.4 | 8.9% |
| 1965 | 50.1 | 11.2 |
| 1970 | 76.2 | 8.8 |
| 1975 | 116.2 | 8.8 |
| 1980 | 168.4 | 7.7 |

These figures, adjusted for the estimated price elasticity effects of a range of possible fare increases of 1 and 5 percent respectively on the volume of domestic trunkline passenger traffic, are as follows:

### DOMESTIC TRUNK PASSENGER TRAFFIC
### Revenue Passenger-Miles
### (billions)

| Year | Forecast | At 1% Fare Increase | At 5% Fare Increase |
|---|---|---|---|
| 1970 | 76.2 | 75.3 | 71.6 |
| 1975 | 116.2 | 114.8 | 109.2 |
| 1980 | 168.4 | 166.4 | 158.2 |

Figures for the FAA forecasts of domestic passenger traffic, but also including local service airline traffic, are as follows:

| Fiscal Year | Forecast | At 1% Fare Increase | At 5% Fare Increase |
|---|---|---|---|
| 1970 | 89.4 | 88.3 | 84.0 |
| 1973 | 126.0 | 124.5 | 118.4 |
| 1977 | 200.0 | 197.6 | 187.9 |

## C. INTERNATIONAL PASSENGER TRAFFIC OF U.S. AIRLINES

The second most important segment of all U.S. airline traffic is accounted for by the passenger traffic of U.S. international and territorial airlines. Such traffic amounts to 20 percent of the total revenue ton-miles of all U.S. certificated route air carriers, and to 18 percent of total revenues.

Probably the best study of elasticity of demand in international passenger traffic was made for IATA by Stephen Wheatcroft, "Elasticity of Demand for North Atlantic Travel" in July 1964. He attempted to make a computer analysis of a 14-year statistical series of traffic and rate data, but reached the conclusion that the multiple regression analysis which he carried out was inconclusive. He said that he was therefore forced to use a much less precise methodology, with the result that his conclusions did not have the rigorous scientific basis that he would have liked, and that they therefore represented, at best, a tentative hypothesis.

His major conclusion was "It can be established beyond reasonable doubt that the growth of personal income is the most important single factor in determining the development of total travel from the United States to Europe." He reached the quantitative conclusion that there was an income elasticity of 2.3, based on disposable personal income.

He ranked price elasticity of demand in second place as an influence on the growth of the market. His coefficients of price elasticity between the United States and Europe were -1.6 in summer and -1.5 in winter, with the difference between the two seasons being due to the different mix of business and recreational travel, but with the latter equally elastic in both summer and winter. His specific elasticities by purpose of travel were:

| | |
|---|---|
| Business | -0.4 to -1.0 |
| Visiting friends or relatives | -2.1 |
| Vacation trips | -2.0 |

At the time, for the years 1953-1963, the relative proportion of business travel in this market was approximately one-third;[2] if it had been reversed to correspond to the domestic distribution by purpose of travel, then the aggregate elasticity, using an average of -2.0 for non-business travel and -.9 for business travel would have been about -1.27.

In considering causal factors for traffic growth, Wheatcroft studied population growth, preference for Europe, other economic factors, advertising and other promotional activities, and political and special events, in addition to income and fare effects. He found a number of these probably operative: "In the period from 1954 to 1960 the average summer fare level remained virtually unchanged. During this same period the total traffic increased by about 10 percent each year. . ."

In his final analysis of U.S.-Europe summer traffic, his hypothesis produced an average annual increase for 1955-63 of 16½% (as compared to 18% actual). The major effects he identified, and the percentage attributable to each, were:

| | |
|---|---|
| 9% | income effect |
| 5½% | fares |
| 2½% | service quality |
| -½% | political events |
| 16½% | total |

There are a number of major influences on air travel. One group is environmental -- total population which measures the number of potential travelers, and income which makes it possible for them to travel, expressed as total, discretionary, disposable, by frequency distribution by family, etc. The other group comprises transportation forces -- price, time, convenience, reliability, safety, and comfort; also associated with these is the relative competition or non-competition among various modes of travel, as air vs. surface, which varies by distance, by ability of each mode to generate new traffic or divert from other modes, etc.

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[2] The Port of New York Authority, Aviation Department, Aviation Economics Division. New York's Overseas Air Passenger Market, April 1963 through March 1964. June 1965. p. 53.

The best way to project international passenger traffic would appear to be to follow the CAB staff methodology developed for domestic passenger traffic, and solve the formula for different quantitative factors of elasticity of demand, incomes, and time trend. This has not been done, however, and the restrictions of time and effort in the present study preclude the substantial amount of work required to do so.

Lacking such a study, an approximation is necessary. Although the price elasticity estimate of Wheatcroft appears to be satisfactory for this purpose, usable estimates of income are not readily available. Those for the U.S. are adequate, but valid estimates for the wide variety of foreign income series by country would need considerably more time and effort. In addition, of course, the time trend of the CAB, comprising all other variables not taken into account by elasticity and income, would require more detailed analysis.

As a practical compromise, therefore, it appears to be most reasonable to relate the growth of international passenger traffic to the growth of U.S. domestic passenger travel, but at the more rapid rate of increase that has been experienced over a long period of time. For this purpose, we can project the relative increase in the ratio of U.S. scheduled international and territorial airline revenue passenger-miles as a percentage of traffic of the domestic trunklines (as shown in Appendix 4), increasing from 23.4% in 1955 to 28.4% in 1960 to 34.3% in 1965, and projected to increase on a trend line to 39.3% in 1970, 40.8% in 1975, and 42.8% in 1980. On this basis, the past and projected growth of scheduled U.S. international and territorial traffic is:

## INTERNATIONAL PASSENGER TRAFFIC OF U.S. AIRLINES

| Year | Revenue Passenger-Miles (billions) | Annual Rate of Growth 5-Year Period |
|---|---|---|
| 1955 | 4.5 | |
| 1960 | 8.3 | 13.0% |
| 1965 | 16.8 | 15.1 |
| 1970 | 30.0 | 12.3 |
| 1975 | 47.4 | 9.6 |
| 1980 | 72.1 | 8.8 |

The effects on these projections of possible increases in fares to pay for airport noise programs, at hypothetical surcharges, will depend upon the elasticities of business and non-business traffic, and upon the relative percentages of each in the total travel mix for all U.S. international air traffic.

The ratio of business to total travel in the North Atlantic is slightly above the total in and out of New York City to all overseas destinations.[3] In 1963, the percentage was 26 for the North Atlantic, composed of 23 percent for American residents and 31 percent for foreign residents. For all markets, it was 24 percent business, composed of 21 percent for American residents and 30 percent for foreign residents. The areas for which data were obtained, in addition to the North Atlantic, included Bermuda (9 percent business), Caribbean (13 percent business) and South America (35 percent business).

The percentage of business travel to the total has been declining in the periods surveyed. In 1956, the total for all markets was 27 percent business, composed of 23 percent for American residents and 39 percent for foreign residents; the corresponding figures for the North Atlantic market were 31 percent of the total, 27 percent for American residents, and 41 percent for foreign residents.

It would therefore appear that over the next fifteen years the ratio of pleasure/personal travel to total for traffic between the U.S. and the rest of the world will be approximately that of the North Atlantic in recent years. We may therefore project an approximate price elasticity in the aggregate of -1.6, and the forecasts for corresponding price increases at surcharges of 1 and 5 percent are:

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[3] The Port of New York Authority, Aviation Department, Aviation Economics Division. New York's Overseas Air Passenger Market, April 1963 through March 1964. June 1965. Pages 16-17.

INTERNATIONAL PASSENGER TRAFFIC OF U.S. AIRLINES
Revenue Passenger-Miles
(Billions)

| Year | Forecast | At 1% Fare Increase | At 5% Fare Increase |
|---|---|---|---|
| 1970 | 30.0 | 29.5 | 27.7 |
| 1975 | 47.4 | 46.7 | 43.8 |
| 1980 | 72.1 | 71.0 | 66.7 |

Similar relationships for the FAA forecasts are as follows:

| Fiscal Year | Forecast | At 1% Fare Increase | At 5% Fare Increase |
|---|---|---|---|
| 1970 | 29.4 | 28.9 | 27.2 |
| 1973 | 41.5 | 40.8 | 38.4 |
| 1977 | 66.0 | 65.0 | 61.0 |

## D. DOMESTIC CARGO TRAFFIC

Forecasting air cargo traffic trends is a task involving the most uncertainty. Although a large number of projections and forecasts have been made, this area of forecasting contains many large inherent difficulties. Unfortunately for all methods, whether based on statistical trends or on detailed analysis of factors causing air cargo to move, the rate of growth has been very rapid and uneven, practically all basic conditions have changed drastically, and the selection of a "normal" base period as well as the method of projection are still largely matters of personal judgment.

Other than simply projecting statistical trends, there appear to be three major approaches to analyzing the primary influences on air cargo growth: lower rates, greater reliability and number of schedules, and greater sales efforts. These views are not in conflict; disagreements center mainly on the degree of weight to be attributed to each.

First, the major encouragement of air cargo increase may be lower rates. Those who are adherents of this theory believe that the demand for air cargo is highly price elastic, although types of shipments and specialized rates are so many and complex that statistical and financial measurements of elasticity are not available. The recent extremely rapid growth in air cargo may be attributed to experience with lowering rates, particularly as contrasted to comparable rate levels of surface transportation and qualities of service.

Second, the growth of air cargo may be largely due to greater reliability and frequency of service. Those who favor this view believe that most shippers give greatest weight to assured delivery times. Shippers can then feel assured that any permanent change they will make in their distribution system will be based on relatively guaranteed transportation timing. They can then plan their entire production-inventory-transportatio distribution system to minimize aggregate costs. These system economic advantages should then exceed the additional costs of air as compared to surface transportation in direct ton-mile rate comparisons.

Third, the rapid growth of air cargo volume may be due to increased carrier selling of their services. Although rate reductions and increased reliability are highly desirable, they can be of effect only after the potential shippers have been made to realize the advantages they will secure by using air transportation. Potential shippers are usually busy executives with many day-to-day decisions to make, and they do not often stop to resurvey their entire operation in the light of potential air cargo savings. In the complexities of modern industry there are many major elements of cost such as labor, sales promotion, raw materials, power, technological development, and increasing competition. Among these important elements, the cost effects of transportation may be relatively neglected, and it is therefore crucial that air carriers educate potential customers to awareness of cost savings made possible by air shipments.

The above three influences are all developing rapidly, as well as the national economy as a whole, total output, competitive marketing relationships, and transportation requirements. This establishes the technical problem of statistical covariance, whereby the influence of one of the co-varying factors cannot be reliably distinguished from the influences of the others.

One of the most recent studies of air cargo growth has been made by Lockheed.4/ We have selected it, in part, because of its recency, and in part because in the course of its preparation it considered a large number of previous air cargo forecasts.

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4/ E. W. Eckard, Marketing Research Department, Lockheed-Georgia Company, a division of Lockheed Aircraft Corporation. Air Cargo Growth Study, Marketing Planning Report MRS-49. December 1965.

The method used in this study was to forecast the Gross National Product at a rate of increase of about 3.5 percent per year in constant dollars, projecting total intercity ton-miles at a rate of 2.45 per dollar of GNP, estimating the penetration of air cargo ton-miles into this total on the basis of a Gompertz growth curve of experienced penetration percentages, and adding a volume of mail due to probable changed policies. The results of this procedure (extended to 1980) are as follows:

DOMESTIC CARGO TRAFFIC OF TRUNK, ALL-CARGO,
AND SUPPLEMENTAL AIRLINES

(Scheduled and Non-Scheduled Freight, Express, and
U.S. and Foreign Mail)

| Year | Revenue Ton-Miles (millions) | Annual Rate of Growth 5-Year Period |
|---|---|---|
| 1955 | 453 | |
| 1960 | 843 | 13.2% |
| 1965 | 1,848 | 17.0 |
| 1970 | 3,861 | 15.9 |
| 1975 | 7,924 | 15.5 |
| 1980 | 14,670 | 13.1 |

Lockheed made a study of the ratio of cargo space available in passenger/cargo aircraft (belly cargo), and assumed that all such space would be used while only the remainder would be carried in all-cargo aircraft. However, past experience has shown that approximately half of the air cargo in a given trunkline or international market moves by combination passenger/cargo aircraft with its typically higher number of frequencies, as long as belly-compartment space is available. The other half usually moves by all-cargo aircraft, for reasons of size, density, the peaking of shipments during certain hours, and other factors. We have therefore forecast that half of all cargo traffic on the trunklines will continue to move by all-cargo planes.

We are aware of no general studies of the price elasticity of demand that have been made for air cargo. In view of the wide discrepancies in the weight given by various analysts to the relative importance of price in the growth of air cargo, it is difficult to estimate even a moderately reliable figure for elasticity. An educated guess would seem to produce a range between -1.5 and -2.0, although some would run this figure up much higher as absolute levels of air cargo rates can be reduced. On this basis, the effects of rate increases of 1 and 5 percent respectively, for added costs of airport noise programs, would produce the following results:

DOMESTIC CARGO TRAFFIC OF TRUNK, ALL-CARGO,
AND SUPPLEMENTAL AIRLINES

Revenue Ton-Miles
(Millions)

| Year | Forecast | At 1% Rate Increase | At 5% Rate Increase |
|---|---|---|---|
| If Elasticity = -2.0 | | | |
| 1970 | 3,861 | 3,785 | 3,502 |
| 1975 | 7,924 | 7,768 | 7,187 |
| 1980 | 14,670 | 14,381 | 13,306 |
| If Elasticity = -1.5 | | | |
| 1970 | 3,861 | 3,804 | 3,588 |
| 1975 | 7,924 | 7,807 | 7,365 |
| 1980 | 14,670 | 14,453 | 13,634 |

## E. INTERNATIONAL CARGO TRAFFIC OF U.S. AIRLINES

The difficulties in forecasting the international air cargo traffic of U.S. airlines are considerable. First, there are all the same problems of greater volatility of trend in cargo traffic as compared to passenger traffic. Second, the relationship of international to domestic trends for cargo is far less clear than for passenger traffic.

In 1955 and 1956, the percentage of domestic to internation air cargo was about 59%. During the next four years, 1957-1960, the ratio fell on a quite consistent year-to-year basis to about 48%. The following four years showed a sudden jump, quite unifor for each of the four years, to about 53%. For the latest year for which figures are available, 1965, the ratio was up suddenly to 63%. The question is: what will be the probable long-run trend of this ratio?

The past appears to be little help in forecasting this relationship, because of its sudden and large changes. The parallel between international cargo and international passenger traffic also appears to be tenuous, since the traffic shipped by the professional traffic managers of exporters and importers is not comparable to the foreign-travel habits and desires of a predominantly tourist market.

From the 1957-1960 period to the 1961-1964 period, the ratio of international to domestic passenger traffic increased by 26% (of its 1957-1960 percentage points), while the corresponding increase in the cargo ratio was only 12%. However, 1965 showed a large jump of almost 20% in the ratio for cargo. We will therefore assume that, for long-range forecasting, the ratio of international to domestic cargo will follow the same percentag of increase in passenger traffic, that is, compared to the 1961-1964 base, the ratio in 1970 will increase by 21%, in 1975 by 26%, and in 1980 by 32%. On this basis, the international air cargo of U.S. international air carriers will be:

### INTERNATIONAL CARGO TRAFFIC OF U.S. PASSENGER/CARGO, ALL-CARGO, AND SUPPLEMENTAL AIRLINES

| Year | Revenue Ton-Miles (millions) | Annual Rate of Growth 5-Year Period |
|---|---|---|
| 1955 | 260 | |
| 1960 | 390 | 8.5% |
| 1965 | 1,172 | 24.6 |
| 1970 | 2,490 | 16.3 |
| 1975 | 5,317 | 16.4 |
| 1980 | 10,328 | 14.2 |

As in estimating the amount of domestic cargo to be carried in all-cargo aircraft, it was assumed that belly space will be used in passenger/cargo planes for half of the future cargo, and that half will move in all-cargo aircraft.

Again, as in domestic air cargo, there appears to be no general agreement on the price elasticity of international air cargo. With a range between -1.5 and -2.0, the effects of rate increases of 1 and 5 percent for incremental added costs of airport noise programs would produce the following results:

### INTERNATIONAL CARGO TRAFFIC OF U.S. PASSENGER/CARGO, ALL-CARGO AND SUPPLEMENTAL AIRLINES

**Revenue Ton-Miles**

**(Millions)**

| Year | Forecast | At 1% Rate Increase | At 5% Rate Increase |
|---|---|---|---|
| If Elasticity = -2.0 | | | |
| 1970 | 2,490 | 2,441 | 2,258 |
| 1975 | 5,317 | 5,212 | 4,823 |
| 1980 | 10,328 | 10,125 | 9,367 |
| If Elasticity = -1.5 | | | |
| 1970 | 2,490 | 2,453 | 2,314 |
| 1975 | 5,317 | 5,238 | 4,942 |
| 1980 | 10,328 | 10,175 | 9,599 |

## F. LOCAL SERVICE AIRLINES

### 1. PASSENGERS

Local service passenger traffic has been increasing at a very rapid and consistent rate for more than a decade. The annual rate of increase 1955-1960 was 16.4%, and for 1960-1965 was 18.1%, for an annual average rate for the decade of 17.2%. This trend has been the product of traffic growth on routes served for a long period of time, of new routes and cities added in a considerable expansion during the period, of trunkline suspensions at many previously competitive points, and of increases in the relative percentage of passengers carried by local service airlines competing with trunklines. If the experienced growth will continue at its 10-year rate, traffic will more than double every five years, as follows:

LOCAL SERVICE PASSENGER TRAFFIC

| Year | Revenue Passenger-Miles (billions) | Annual Rate of Growth 5-Year Period |
|---|---|---|
| 1955 | .535 | |
| 1960 | 1.142 | 16.4 |
| 1965 | 2.621 | 18.1 |
| 1970 | 5.792 | 17.2 |
| 1975 | 12.800 | 17.2 |
| 1980 | 28.288 | 17.2 |

The price elasticity of passenger traffic on the local service airlines appears to be considerably lower than that of the trunklines. The first difference is the great disparity of on-line passenger trip length, averaging 213 miles for local service airlines in 1965 as compared to 701 miles for the trunks. About half of the local service passengers are connecting with trunklines, so that the local service portion of their travel is a minor part of their total journey; if a passenger on a through journey travelled the average distance on each type of airline as above, the local service portion would be less than one-quarter of the total. It appears logical that, for this half of the local service passenger traffic, a reduction or increase in price for the local service portion of the ticket alone would affect only one-quarter of the total price of the through ticket, and its elasticity effect would therefore be only one-quarter the amount otherwise expected.

Even for the half of the total passengers who are on-line, there is another factor tending to reduce the probable price elasticity for local service passengers: the low absolute dollar value of the ticket. The average local service revenue per passenger was only $16.52 in 1965, compared to $41.61 for the domestic trunklines. A relatively small percentage change in price, therefore, amounts to fewer dollars, and could logically be expected to have a lesser effect on potential passengers.

Still a third factor tending to reduce the price elasticity of local service passengers is their higher percentage of business to personal travel, as compared to the trunklines.

When all of these factors are considered, the best approximation to the probable price elasticity for local service passengers as a whole would appear to be close to unity. On this basis, fare increases of 1 and 5 percent would produce the following effects:

**LOCAL SERVICE PASSENGER TRAFFIC**
**Revenue Passenger-Miles**
**(Billions)**

| Year | Forecast | At 1% Fare Increase | At 5% Fare Increase |
|---|---|---|---|
| 1970 | 5.8 | 5.7 | 5.5 |
| 1975 | 12.8 | 12.7 | 12.2 |
| 1980 | 28.3 | 28.0 | 26.9 |

## 2. CARGO

The growth of local service cargo has shown the same general pattern as that for passengers, but at a higher rate of increase, as follows:

## LOCAL SERVICE CARGO TRAFFIC

(Freight, Express, U.S. and Foreign Mail in Scheduled Service)

| Year | Revenue Ton-Miles (millions) | Annual Rate of Growth for 5-Year Period |
|---|---|---|
| 1955 | 4.368 | |
| 1960 | 9.760 | 17.4% |
| 1965 | 27.801 | 23.3 |
| 1970 | 72.978 | 20.3 |
| 1975 | 191.567 | 20.3 |
| 1980 | 502.863 | 20.3 |

Here, again, the elasticity of demand for cargo on local service airlines is probably far less than for the trunks. The same factors are responsible: the relatively short on-line haul for local service carriers, the low absolute dollar charge per shipment, and the higher percentage of connecting cargo traffic with the consequently lesser influence on the total charge of the local service portion of the haul. In addition, because cargo generally is sent by professional traffic managers, the advantages to the shippers of air speed and convenience probably weigh more heavily than do small changes in unit cost per ton-mile.

Assuming the price elasticity of local service cargo is close to unity, the forecast traffic above would be as follows with increased rates of 1 and 5 percent respectively:

## LOCAL SERVICE CARGO TRAFFIC

Revenue Ton-Miles

(Millions)

| Year | Forecast | At 1% Rate Increase | At 5% Rate Increase |
|---|---|---|---|
| 1970 | 73 | 72 | 69 |
| 1975 | 192 | 190 | 183 |
| 1980 | 503 | 498 | 479 |

Summaries of these forecasts, and of FAA traffic forecasts are shown in the accompanying tables.

## SARC TRAFFIC FORECASTS, AND AT 1 AND 5 PERCENT RATE INCREASES
## ACTUAL 1955, 1960, 1965, AND
## ESTIMATED 1970, 1975, 1980

| Year | Revenue Passenger-Miles (Billions) |  |  |  | Revenue Cargo Ton-Miles (Millions) |  |  |  |
|---|---|---|---|---|---|---|---|---|
|  | Domestic Trunk | U.S. International | Local Service | Total | Domestic Trunk 1/ | U.S. International | Local Service | Total |
| 1955 | 19.2 | 4.5 | .5 | 24.2 | 453 | 260 | 4 | 717 |
| 1960 | 29.4 | 8.3 | 1.1 | 38.8 | 843 | 390 | 10 | 1,243 |
| 1965 | 50.1 | 16.8 | 2.6 | 69.5 | 1,848 | 1,172 | 28 | 3,048 |
| **At Forecast Rates:** |  |  |  |  |  |  |  |  |
| 1970 | 76.2 | 30.0 | 5.8 | 112.0 | 3,861 | 2,490 | 73 | 6,424 |
| 1975 | 116.2 | 47.4 | 12.8 | 176.4 | 7,924 | 5,317 | 192 | 13,433 |
| 1980 | 168.4 | 72.1 | 28.3 | 268.8 | 14,670 | 10,328 | 503 | 25,501 |
| **At 1% Rate Increase:** |  |  |  |  |  |  |  |  |
| 1970 | 75.3 | 29.5 | 5.7 | 110.5 | 3,804 | 2,453 | 72 | 6,329 |
| 1975 | 114.8 | 46.7 | 12.7 | 174.2 | 7,807 | 5,238 | 190 | 13,235 |
| 1980 | 166.4 | 71.0 | 28.0 | 265.4 | 14,453 | 10,175 | 498 | 25,126 |
| **At 5% Rate Increase:** |  |  |  |  |  |  |  |  |
| 1970 | 71.6 | 27.7 | 5.5 | 104.8 | 3,588 | 2,314 | 69 | 5,971 |
| 1975 | 109.2 | 43.8 | 12.2 | 165.2 | 7,365 | 4,942 | 183 | 12,490 |
| 1980 | 158.2 | 66.7 | 26.9 | 251.8 | 13,634 | 9,599 | 479 | 23,712 |

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1/ Trunk, all-cargo, and supplemental.

## FAA TRAFFIC FORECASTS
## AND AT 1 AND 5 PERCENT FARE INCREASES

Revenue Passenger-Miles
(Billions)

| Fiscal Year | Domestic | U.S. International | Total |
|---|---|---|---|
| **At Forecast Fares:** | | | |
| 1965 | 47.3 | 15.3 | 62.6 |
| 1970 | 89.4 | 29.4 | 118.8 |
| 1973 | 126.0 | 41.5 | 167.5 |
| 1977 | 200.0 | 66.0 | 266.0 |
| **At 1% Fare Increase:** | | | |
| 1970 | 88.3 | 29.0 | 117.3 |
| 1973 | 124.5 | 40.8 | 165.3 |
| 1977 | 197.6 | 65.0 | 262.6 |
| **At 5% Fare Increase:** | | | |
| 1970 | 84.0 | 27.2 | 111.2 |
| 1973 | 118.4 | 38.4 | 156.8 |
| 1977 | 187.9 | 61.0 | 248.9 |

# FAA TRAFFIC FORECASTS
# AND AT 1 AND 5 PERCENT FARE INCREASES

## Revenue Passenger-Miles
## (Billions)

| Fiscal Year | Domestic | U.S. International | Total |
|---|---|---|---|
| **At Forecast Fares:** | | | |
| 1965 | 47.3 | 15.3 | 62.6 |
| 1970 | 89.4 | 29.4 | 118.8 |
| 1973 | 126.0 | 41.5 | 167.5 |
| 1977 | 200.0 | 66.0 | 266.0 |
| **At 1% Fare Increase:** | | | |
| 1970 | 88.3 | 29.0 | 117.3 |
| 1973 | 124.5 | 40.8 | 165.3 |
| 1977 | 197.6 | 65.0 | 262.6 |
| **At 5% Fare Increase:** | | | |
| 1970 | 84.0 | 27.2 | 111.2 |
| 1973 | 118.4 | 38.4 | 156.8 |
| 1977 | 187.9 | 61.0 | 248.9 |

## G. GENERAL AVIATION

The best study of present and forecast general aviation fleet and operations is that of the FAA.[5] Since its forecasts were for 1975, using 1964 as a base, we used the annual rate of increase estimated by FAA for 1964-1975, and computed the growth at the same rate for 1970 and 1980.

The four major types of flying were classified by FAA as business, commercial (including aerial application, air taxi, and industrial/special), personal, and instructional, with a small number of others. A summary of totals (amplified by classification in Appendix 5) is:

| Year | Number of Aircraft | Hours Flown (000) |
|---|---|---|
| 1954 | 61,180 | 8,888 |
| 1964 | 88,742 | 15,738 |
| Annual Increase | 3.8% | 5.9% |
| 1970 | 121,870 | 22,311 |
| 1975 | 160,000 | 29,970 |
| 1980 | 210,050 | 40,310 |
| Annual Increase | 5.5% | 6.0% |

The estimated proportion of turbine-engine aircraft, both turbo-prop and turbo-jet, is only very approximate. As the FAA report states, ". . .because of the limited data base currently available, any projection of the future size of the general aviation fleet must be considered as extremely tentative." (p.80) From the 306 actual turbine-engine aircraft in 1964, FAA estimated that there would be 4,000 by 1975, of which 3,100 would be in business use, 800 in commercial use, and 100 in personal use. If it is assumed that a constant number of such planes will be added per year, the approximate numbers will be:

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[5] Federal Aviation Agency, Office of Policy Development, Economics Division. General Aviation, a Study and Forecase of the Fleet and Its Use in 1975. July 1966.

| Year | Number of Turbine-Powered Aircraft |
|---|---|
| 1964 | 306 |
| 1970 | 2,350 |
| 1975 | 4,000 |
| 1980 | 6,050 |

It is quite possible that these estimates are too low. However, the percentage rate of growth has been extremely high during which turbine-powered aircraft have been used in general aviation, and the base period has been extremely short, so that the method of projecting on experienced annual percentage rates of growth used elsewhere in this report does not seem appropriate here. If the annual rate of increase of 26 percent estimated by FAA for the period 1964-1975 were extended another five years, the number of general aviation turbine-aircraft would more than triple to exceed 12,000 by 1980.

## H. FOREIGN AIRLINES AT U.S. AIRPORTS

The same basic factors affect the traffic and operations of foreign airlines at U.S. airports as affect the traffic and operations of the U.S. flag international air carriers operating between the U.S. and foreign countries. The major differences in the past have been diverse trends that have altered the relative sharing by airlines of different flags in the common pool of traffic.

Up to a few years ago, the foreign airlines were gaining in percentage of total traffic carried in and out of the U.S., as compared to the U.S. carrier share. This was generally part of a long-term trend from the post-World War II days when the U.S. carriers began international operations at a level far above that of the foreign countries which had been the scene of active warfare. As a long-term trend, most of the increase in foreign-flag operations was due to initiation of new routes by new foreign-flag carriers, rather than to increasing shares of established foreign airlines.

This trend seems to have stopped in the last few years. For the years 1962-1965, the percentage of U.S. carrier to total traffic in and out of the U.S. showed a very small range between 49.1 and 50.4 percent, with no discernible trend up or down. Similarly, in the extremely important U.S.-Eurpoe market, the U.S. flag participation showed a small range of values, from 39.2 to 41.3 percent, again with no discernible trend.

In estimating future trends of foreign flag airlines, therefore, the most logical assumption seems to be that they will continue to carry very close to half of the total passenger traffic between the U.S. and foreign countries. Since their types of aircraft, scheduling, and operations are comparable to that of U.S. carriers, and the market influences the same, we can forecast that the operations and traffic of foreign flag airlines at U.S. airports will be equal to those of U.S. airlines. If any charges are to be made on a non-discriminatory basis for operations of aircraft at U.S. airports in international traffic, therefore, the dollar volumes from foreign flag airlines should equal those from U.S. flag airlines.

## IV. ABILITY OF AIRLINES TO PAY ADDITIONAL COSTS

### A. GENERAL

A key question is whether, in view of recent high airline profits, their future financial ability will enable them to absorb the costs that may be incurred for new noise alleviation programs, without raising their prices so as to pass on the additional expenses to their customers.

As will be noted from the more detailed analysis in this chapter, our conclusion is that the projected future picture of the airlines -- traffic, revenues, and expenses -- makes it appear likely that total revenues will comfortably cover total expenditures, including a fair return on investment according to standards of reasonableness established by the CAB. The margin of profit is estimated to be above this level for the next decade, and to fall somewhat below it further in the future Of course, considering the large number of assumptions as to the national economy and its trends and airline operations, the estimated margins can not be considered as precise. What seems quite clear is that the airlines are forecast to be able to achieve their approximately proper profit level.

However, on the same basis, it does not appear that the airlines will be financially able to absorb from profits any unusual or large expenses not appearing in our assumptions, such as possibly high-cost noise alleviation programs. It therefore appears logical that, if such costs were to be levied against air transportation via the airlines, the airlines would in turn pass on the cost to their traffic through higher rates.

There are, of course, a number of possible claimants for potential airline future profits. Labor is one of these, as evidenced by the recent wage increases for mechanics and others. Airports have also shown a strong upward pressure in their charges to airlines, for the expense of other programs not including noise alleviation. The Federal government has for many years recommended to Congress a scale of user charges by which to recover the cost of FAA airway facilities allocable to airline operation. Interest rates on loans have been rising, for the airlines as well as for the rest of the national economy. Financing considerations are becoming more important for the huge new aircraft equipment programs of the airlines, and consequent financial demands for more assured rates of return and higher equity-debt ratios. The rising price level for the economy in general -- inflation -- can also cost airlines more in their purchases of fuel, goods, and services in the same common markets as all other industries.

In the long run, airlines like other industries can obtain their revenues only from their customers -- the travelers and shippers. If they have temporarily high profits, and there is resistance to price increases from the customers or from the regulatory agency, they might currently absorb some added costs without raising their prices. In the longer run, it seems unlikely that the Civil Aeronautics Board would allow the airlines to maintain a level of unduly high profits without taking action in one or more of the regulatory areas of fare reductions, added route competition, increased competition for charters, etc.

In any event, it appears likely that any substantial increase in airline costs will be reflected in airline prices. If this should not result in an absolute increase in fares and rates, then it would result in maintaining prices above the level to which they might otherwise be lowered in the absence of the increased costs. As a practical matter, it seems likely that the permutations and combinations of other airline costs of varying magnitude and timing will be far more important and will substantially blanket the probable effect of the cost of airport noise programs.

Airline profitability does not vary only with fare and rate levels, costs, and total volume. In dynamic growth, operations must be projected by management with a long lead time ahead of the development of traffic, and many long-term expense commitments are made. The extent to which the estimat traffic in fact later materializes, and the projected unit cos are achieved, is always problematical.

It should also be pointed out that this chapter makes an analysis of probable future airline traffic and operations at a level of fares estimated to remain constant in terms of 1966 dollars. It does not, as did the previous chapter on traffic effects, pursue the analysis into the possible financi results of increasing fares and rates. If rates were to be ra and traffic did as a consequence decline, airline operations a capacity provided would presumably also change as the manageme adapted their service levels to the changing traffic volumes. Under these circumstances, of course, expenses would also diff from those based on the assumptions stated in this chapter.

The specific question to be resolved here is whether the projected revenues of the air carriers will be sufficient to re cover the total costs of providing the capacity to service the traffic, to absorb such increases in those costs as may reasona be forecast, to provide an adequate return on investment, and t leave a margin from which the costs of airport noise alleviatio could be wholly or partially defrayed. In the case of the loca service carriers, the impact upon likely subsidy levels must al be considered.

In the treatment of each of these elements, there are cert basic assumptions which must be made. Traffic development and its responsiveness to price changes is treated elsewhere in thi study. Given the projected levels for the various kinds of air traffic, the capacity requirements necessary to provide adequat service are readily determinable, with variations in load facto the primary reflection of the impact of competition. In other words, a given traffic level could be accommodated by a single carrier serving a route with less available capacity than with two or more carriers. With the present levels of competition, where multiple carrier operations exist on virtually every high-density route, the load factors used in the analysis must and do suggest certain amounts of unused capacity, which will vary with the nature of the operation (trunkline as against local service, for example) and with the amount of traffic density which can reasonably be anticipated.

Another factor is the tendency for air carrier unit costs to move upward, after taking into consideration increases in efficiency. The high percentage of airline costs which is comprised of labor and manpower outlay gives substantial leverage to this tendency, since the generally high level of skills involved has buttressed the bargaining position of the several labor groups. Intense competition for qualified personnel, in the case of carrier operations, and for the product of their work, in the case of aircraft manufacturers, will undoubtedly continue to affect virtually the entire spectrum of air carrier costs.

A third factor is the problem of fleet mix, complicated by continuing technological change. It is virtually impossible to forecast the number of "jumbo" jets of the B-747 type that the domestic trunk carriers will individually decide to operate; reasonable assumptions must be made, with the high-capacity jets reserved for high density markets, and jets of the present families deployed in proportions roughly similar to those prevailing today. It can also safely be assumed, irrespective of the intensity of passenger demand, that piston and turbo-prop equipment will be phased out, with some portion of the latter remaining in short-haul local service markets.

Within these broad areas of inquiry, the future profitability of the air carriers, or their capacity to absorb costs beyond those projected, is summarized in the following table:

| | (millions of dollars) 1965 | 1970 | 1975 | 1980 |
|---|---|---|---|---|
| Return Element Required: | | | | |
| Domestic Trunks | | $549 | $ 643 | $ 899 |
| International | | 190 | 245 | 411 |
| All-Cargo Services | | 43 | 89 | 171 |
| Total | $355 | $782 | $ 977 | $1,481 |
| Net Income: | | | | |
| Domestic Trunks | | $543 | $ 681 | $ 738 |
| International | | 228 | 383 | 549 |
| All-Cargo Services | | 32 | 32 | 28 |
| Total | $460 | $803 | $1,096 | $1,315 |
| Excess (Shortage) of Income | $104 | $ 21 | $ 119 | $ (166) |
| Subsidy Needs - Local Service Carriers | $ 65 | $ 47 | $ 24 | $ 4 |

NOTE: Future data summarized from Appendices 8E, 8G, 9D, 9F, 10G, 11A, and 11B. 1965 detailed breakdown not comparable because "all-cargo services" for future years include allocations for operations of all-cargo aircraft among domestic trunk and international carriers, in addition to reported exclusively all-cargo domestic and international airlines.

Under the FAA forecast, the traffic level we have projected for 1980 would be achieved three years earlier, in 1977. If their estimated annual rate of increase of 12.2 percent for previous years continued to 1980, total traffic would have grown by 41 percent to 375 billion revenue passenger-miles. It is likely that such a large increase would be carried at a slightly higher load factor of probably one percentage point, but that the continuing rise in prices paid for airline manpower and material would almost keep pace as it has done historically. The final results of achieving the FAA traffic estimates by 1980 would probably therefore improve the airlines' financial status somewhat, leaving them with a reasonable return after paying all forecast costs.

It can be seen that for the next 15 years as a whole the industry shows no projected profit available for the absorption of an additional large cost element without price changes, nor does it appear to be headed for adverse financial problems foreseen in our underlying assumptions.

### B. TRAFFIC

Elsewhere in this study, forecasts have been made of the traffic which can reasonably be expected in 1970, 1975 and 1980 by the domestic trunks, the local service carriers, the international carriers, and the all-cargo carriers, domestic and international. These forecasts represent the market potential for air travel and air carriage, based on historical and existing trends, and assuming a continuity in marketing effort, competition, and public acceptance. These levels have been used in constructing the traffic flow for determining gross airline revenues in the respective forecast periods.

### C. REVENUES

Even though an unchanged fare in an inflationary market is a reduced fare in real terms, it is unlikely that airline fares and rates will be permitted to move upward with general price trends; rather, there will most probably be pressures for fare reductions. Accordingly, increases in airline revenues will result almost entirely from growth in traffic. It should be borne in mind that traffic growth beyond the levels projected here would subject whatever additional profits were produced to corresponding pressures for fare reductions.

### D. CAPACITY

It is in this area that the maximum leverage to profit increases could exist if any air carrier were in a true monopoly position. Considering the unused offered capacity which characterizes air carrier operations, the monopoly carrier could increase capacity at a substantially slower rate than traffic growth, achieving greater seat utilization at modest increases in passenger servicing costs.

This is not the situation which presently exists, nor is it likely in the future. Multiple-carrier competition is the overwhelming rule rather than the exception, and with the peaking o passenger demands, on a daily, weekly and seasonal basis, competing carriers must provide service which will show extreme variations in load factor, and must design their capacity plans to achieve an over-all performance which will hopefully be profitable. The average load factors used herein are those whi can reasonably be expected, by type of service, and are based upon assumptions of continuing competitive effort. Pressures by the airlines to drop low-density points or to concentrate upon the more lucrative markets will undoubtedly continue. The effect, however, is already in part reflected in historic load-factor data.

Minor variations may be expected, especially as between individual carriers. The impact of high-volume jets cannot yet be accurately measured; the stimulus of jet convenience in short-haul markets is another unknown. Given the load factors assumed, the required seat offering is readily determinable, and the application of the projected fleet mix by type of servic permits the projection of operating programs.

Aircraft utilization, up to a certain level, is also a lever to additional profit. However, the rates of daily utilization shown are believed to reflect the best levels possible for the various segments of the industry, after taking into account ground-time requirements, passenger preference for time-of-day, stage length, and such other factors as affect usable seat-mile production.

## E. METHODOLOGY

Appendices 6A through 11B and their accompanying notes show the method for developing the estimated profitability for each segment of the industry, and the sources of the data employ

## F. CONCLUSION

We believe that the airlines cannot in the long run bear any substantial cost of airport noise programs out of profits.

Their only source of income is revenues from passengers and shippers. Their profit margin over a fair rate of return is, over a period of time, relatively narrow compared to their level of expenses -- a surplus in 1970 and 1975, and a deficit below a fair return in 1980 of about $166 million on a gross transport revenue of some $20,800 million.

Again, despite all the variables in absolute levels of future expenses and consequent margins under probable revenues, the key consideration in this analysis is the effect of the different assumptions on traffic volume. It appears likely that, unless airport noise program costs would be large in proportion to all other expenses, their actual effect will be concealed by large changes in all other cost variables. In addition, it seems that in the long run the CAB will use some of its regulatory powers to limit the upper level of profit margins. It therefore appears at this time to be logical to assume that the airlines would pass on to the customers the full long-term cost of airport noise programs with which they might be charged, either in raising the absolute level of fares and rates, or in not decreasing them commensurate with possible reductions in cost levels.

In any event, the forecast financial condition of the airlines is comfortable. Their revenues seem likely to cover foreseeable expenses and provide profits to give them a reasonable return on their investment approximately equal to the guidelines established for them by the CAB.

## G. EFFECT OF ADDED COSTS ON GENERAL AVIATION

The extremely great diversity of general aviation aircraft and operations makes it difficult to estimate the effects of levying added charges on them to help pay for airport noise programs. Sizes of aircraft vary from small single-engine piston planes up to twin-engine turbojet aircraft comparable in capacity to those of local service airlines. Uses vary, from private and instructional planes making local flights to corporate aircraft on long-distance trips, and including special industrial uses such as surveys and aerial application of chemicals.

Similarly, there is wide variation of costs. There differences in fuel consumption and types of fuel, and the us of professional salaried flight personnel or operation by the owner of the plane without payment. Of more importance when considering possible additional costs for new programs to all ate noise is the great variability in the manner that airport charge general aviation landing fees. Some of them charge no at all, often desiring the traffic as a contribution to the locality's economy or for sales of fuel and other services. of the largest metropolitan airports charge high fees, with t objective of excluding as many general aviation operations as possible from crowded airports, to leave more capability to handle airline flights. Most airports fall between these ex charging individually in accordance with their own policies a specific situations.

In addition, most general aviation flying is not on commercial basis comparable to the airlines. Most of their p poses are not to produce a cash income, or to service general public transportation needs. Their accounting methods reflec this, mostly without a revenue side to their ledger, and with widely varying costing methods. We will therefore not estima the financial results of increases in cost on their profit-a loss accounts, but simply illustrate the order of magnitude o such cost increases if applied on some uniform basis of charg

The number of landings and take-offs annually per air craft, on which airport charges might be levied, is also vari The broad general aviation average is about 90 to 100 per air craft per year. In 1962 it was 87, but since instructional f ing performs many landings and take-offs in proportion to num of aircraft -- perhaps four landings per single trip with pra operations -- the remainder of the general aviation fleet pro averages about 50 per year.

The accompanying table shows illustrative landing fees for a number of typical general aviation aircraft, and the change which would result from a surcharge of one dollar per landing. Obviously, these illustrative prices are relatively insignificant for any one general aviation aircraft. The total yearly charge has been calculated for an average of 50 landings per aircraft. However, it should be pointed out that only the turbo-jets are the type causing such noise levels as to lead to possible airport noise programs in the future. The number of such aircraft in the general aviation fleet is very limited, estimated by FAA to total only 1500 in 1975. Their estimated annual utilization in 1975 is also forecast by FAA to be 753, so that, if they average two-hour flights, the number of annual landings per aircraft would probably be just under 400, and their applicable dollar values would therefore be about eight times that shown in the table.

If charges were levied on the basis of fuel used, and if taxes were applied only to jet fuel for noise programs, the volume of operations on which taxes are collected would similarly be very small as a percentage of general aviation operations as a whole.

## GENERAL AVIATION AIRCRAFT
## SELECTED MODEL CHARACTERISTICS AND LANDING FEES

| Aircraft | Manufacturer | Power Plant | Seating Capacity | Gross Weight (Pounds) | Present Landing Fee[1] | Landing Fee With $1 Surcharge | Annual Landing Fees For 50 Landings - Present | Annual Landing Fees For 50 Landings - Surcharge |
|---|---|---|---|---|---|---|---|---|
| 150 Commander | Cessna | 1 piston | 2 | 1,600 | 0 | $1 | 0 | $ 50 |
| 185 Skywagon | Cessna | 1 piston | 6 | 3,300 | 0 | $1 | 0 | $ 50 |
| Aerostar 320 | Ted Smith Aircraft | 2 piston | 6 | 3,800 | $ .15 | $1.15 | $ 7.50 | $ 57.50 |
| Aztec | Piper | 2 piston | 6 | 4,800 | $ .30 | $1.30 | $ 15.00 | $ 65.00 |
| Skyknight | Cessna | 2 turboprop | 6 | 5,300 | $ .30 | $1.30 | $ 15.00 | $ 65.00 |
| Queenair | Beech | 2 piston | 6-9 | 8,800 | $ .90 | $1.90 | $ 45.00 | $ 95.00 |
| Learjet 24 | Lear | 2 turbojet | 8 | 13,000 | $1.50 | $2.50 | $ 75.00 | $125.00 |
| Gulfstream I | Grumman | 2 turboprop | 10-20 | 36,000 | $4.95 | $5.95 | $247.50 | $297.50 |
| Gulfstream II | Grumman | 2 turboprop | 10-24 | 54,000 | $7.65 | $8.65 | $412.50 | $462.50 |

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[1] Washington National Airport Scale: 15¢ per 1,000 lbs. over 3,500 lbs. gross. Under 3,500 lbs. exempt.

## V. ALLOCATION OF COSTS TO PUBLIC BENEFITS

### A. BASIC APPROACH

The argument is often made that there are economic, political, national defense, and other benefits to the general public from air transportation which would justify a policy that some or all of the cost of programs to alleviate airport noise in the United States should be obtained from the general tax revenues of the Federal Government. Before establishing or rejecting such a policy, this argument must be carefully examined and resolved.

In analyzing and allocating the costs of new programs to alleviate aircraft noise around airports, a major initial consideration is identifying the benefits of air transportation. Both the benefits and the beneficiaries are of two kinds -- direct and indirect. The direct beneficiaries are the passengers and shippers who use aircraft, and their benefits are primarily the consequences of their time savings, when accompanied by adequate safety, comfort, availability, capacity, and reasonable pricing. Another major type of beneficiary may be the general public who receive indirect benefits from the added traffic and economic activities accompanying air transportation.

#### 1. Direct Beneficiaries

This analysis is from the point of view of economics. First, it must be pointed out that economics is only one aspect of life in the United States. There exist other major aspects -- social, political, psychological, national defense, international relations -- each of great weight in any policy decision, and often of greater weight than economics.

Second, as far as economic theory is concerned, air transportation must be considered within the framework of the American free enterprise system. The total market is composed of very many completely free potential consumers of goods and services, each deciding what to purchase, in what quantities and qualities, and at what price, as seems best to himself.

Likewise, these goods and services are provided by many potential producers, each using his own initiative and managerial judgment as to what quantities and qualities of commodities or services to produce and at what price.

Within this system, pricing is a key mechanism. Each producer establishes his prices in view of his own costs, the prices set by his competitors, and what he thinks the market will pay. He purchases all the factors of his production in common markets -- labor, capital equipment, supplies, managerial ability, advertising -- whatever he believes he requires for his production. The sellers of these factors of production are also in common markets, to sell or withhold their factors among all potential purchasers.

Obviously, this is an ideal and theoretical statement of the free-enterprise market-centered economy, and is subject, of course, to many practical qualifications and limitations including non-economic ones. But basically, any single producer must buy all his factors of production; nothing of value is willingly given to him by anyone else without charge; and in order to stay in business he must receive from his customers at least sufficient income to pay for all his expenses.

In air transportation, as in all other industries, this means that the producer pays for all his costs of production. In turn, he charges his customers prices such that he grosses at least enough income to pay for all these costs. On this basis, air transportation should pay for all the costs it legitimately incurs -- including the properly allocable costs of such services as airports, airways, and noise programs, as well as those normally paid for without question such as labor, aircraft, fuel, interest on loans, etc.

However, when we look at the practical world of transportation as it has developed up to now, in its full context of political and social developments as well as economic, we find the widest range of payment practices. For example, some capital facilities are financed privately, such as railways and pipelines, while others are provided by public agencies, such as highways, waterways, airways and airports. Of the publicly provided facilities, some are fully paid for by the users as a whole, as for highways, some not at all, such as for inland waterways, and some in part, such as airways and airports.

The first step in our analysis, then, is to identify the direct beneficiaries and evaluate the benefits to each. In this instance, those who specifically cause the costs are easy to identify. The only source of noise is the aircraft landing and taking off at the airport, particularly the jets which make the noise problem so acute as to require program expenditures. The direct beneficiaries of these aircraft operations are the users -- passengers, shippers, airmail, and general aviation operators.

2. Indirect Beneficiaries

In addition to direct benefits, there are, throughout our economy, indirect benefits. Indirect beneficiaries are more difficult to identify with precision to measure their specific benefits. Among them are the airlines, who operate the bulk of the commercial aircraft, who are the channel through which most of the direct beneficiaries pay, and who share the benefits of air transportation through profits and increases in the value of their equipment and enterprises. Some of the nearby property owners may also be beneficiaries, if they own property whose value may increase for industrial or commercial purposes because it is close to the air transportation activities; other property owners, particularly those whose property is used for residential purposes, are more likely to suffer rather than benefit.

On a broader scale, whole localities may be beneficiaries, in the sense that their economies are better off with modern air transportation than without it. Probably most such benefits are competitive in nature, on the basis that if the locality is without jet air transportation it may lose out to competitive markets who have it. This is the practical reason why, for example, there is rivalry between nearby airports such as Baltimore and Washington. At each airport, the airlines and concessionaires employ personnel whose payrolls are spent in part in the locality; incoming passengers spend at the airport and at hotels and restaurants in the cities served; conventions are promoted to do the same in larger groups; local businesses can increase their volume by greater accessibility to customers and from suppliers.

However, air transport as an industry in this respect does not differ from any other economic activity. Localities also try to induce industrial plants and other facilities to build in their area for similar benefits, often through some type of subsidy such as tax exemptions.

Still broader are the benefits to the nation as a whole from the advantages of the faster air transportation of the jets which cause the major noise problems.

However, the national economy as a whole also benefits from increases in individual advantages from other segments of industry and consumer purchases. Industries such as the travel industry and its components increase their volume and often decrease their unit costs when air transportation and its benefits increase, but they also do so through increases in other transportation activity such as private automobile traffic which does not thereby deserve a 'subsidy' through charging off some of its cost to public benefits and the public taxpayer. Similarly, manufacturers and others who ship by air benefit the economy, through better service to their customers or through the reduced costs of a more rapid and efficient distribution system, but, again, no more justified for subsidization of air transportation than improvements in the railroad or trucking industries.

The measurement of secondary benefits generally is still in a rudimentary state of development. One of this type of attempted measurement is the "multiplier" effect of any economic activity spreading out through the entire national economy. It has been estimated, through aggregate statistical methods, at about 2 -- that is, one dollar spent directly on or left with consumers by tax reduction, in turn causes purchases of services and goods of about two dollars in industries throughout the country.[6] Another technique, being developed on a much more precise quantitative basis, is input-output analysis, in which a matrix is developed showing the total interlocking purchases and sales between all major classifications of industry.

Of course, noise around airports is in the nature of a negative benefit rather than a positive good. It produces a cost to members of the public in the affected areas, while it is allowing a specific and private benefit to the producer. In an illustrative analogy, it is comparable to a steel mill or oil refinery which, in the pursuit of its own aims, may add to the pollution of air and waterways by burning some of its wastes through smokestacks and dumping other industrial wastes into rivers. Large segments of the public consequently are penalized by higher cleaning bills, increased lung ailments, added expenses in obtaining and purifying water, loss of recreational uses of rivers, etc. In order to reduce or eliminate these public costs, the mills might be required to add special devices to their smokestacks, and to process their waste materials other than by throwing them raw into the rivers. Should the Federal or other governments, and through them the general taxpayer, be required to pay for such devices on private facilities?

This is a basic public policy question of whether any producer, in the course of his production, should burden the general public with the indirect costs of his processes, or whether he should bear these costs and then charge his customers for them through his prices. Aside from the short-term practicality of sudden expenses, it appears that the same long-term public policy is involved in airport noise programs as in the amelioration of other industrial processes such as smog, garbage dumps, water pollution, etc. The costs of noise at airports should be consistent with all other public policy -- to charge the cost of ill effects of industrial processes to the producer of the ills and through him to the purchaser of his products through the normal pricing mechanism of our economy -- or to allow him to dispose of his industrial wastes in a way to minimize the cost to himself and his customers, and make the public at large pay for correcting the consequences.

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[6] Economic Report of the President, January 1964.

## B. NATIONAL DEFENSE

Another argument frequently advanced as to why the general public should bear some of the costs of air transportation is the national defense and military standby value of airlines, airways, and airports. There can be no question but that these are all valuable to the nation. The basic question is whether or not they are different in principle from the value of other national resources. Again, we may take the parallel case of a steel mill or oil refinery. Both are of great importance to the national defense posture of the country. Should the cost of these installations therefore be charged off in part to the public benefit, and be subsidized by taxation or other special treatment? When looking over the tremendously complex and interwoven structure of our national economy and the large number of facilities essential to our national welfare and survival, it would appear that most industries would be eligible for subsidy. On this basis, it does not appear that air transportation is unique in its essentiality to the national defense. It should therefore operate the same as the rest of private industry in this respect -- bear all its own legitimate costs, and charge them to its customers through its pricing system.

Of course, current operations of military aircraft at civil airports are a legitimate cost to the public interest, and allowance should be made for them. This is recognized in FAA studies of user charges, and appropriate adjustments have been included in its proposals for recovery of costs through fuel and other taxes.

## C. USER CHARGES AND THEIR EVALUATION

As a part of this analysis, we made a study of the ways in which other transportation and natural resource developments have treated the same problem of allocating responsibility to public benefit.

Most such analyses center on methodologies by which to allocate costs and benefits against multiple-purpose projects, as water resource developments (navigation, irrigation, hydroelectric power, flood control, water supply), airways (civil vs. military use), highways (vehicles of different characteristics and classifications), and costing of rail and motor carriers. In general, these methods are used in situations where allocations must be made between several objectives of a project. In dealing with the costs of airport noise, however, the purpose of the project is the single one of servicing aircraft traffic.

For allocating between actual airport users as compared to the general public, the major analytical idea appears to be the establishment of yardsticks of benefit. This, however, is primarily to analyze, in each specific case, the benefits to non-aircraft operators at the airport and in its vicinity, such as industrial airparks or other special facilities that depend on the airport activity and which can afford to pay additionally for the greater benefits produced by the operation of noisier aircraft.

Other methods that have been applied are for the allocation of costs and benefits as between various groups of users, and not for responsibility to the general public taxpayer.

None of the agency literature examined contains a specific economic rationale for allocating any proportion of transportation costs to the general public. Waterway development, as one part of multi-purpose projects, calculates user charges which are then in turn translated by the agencies into Federal sponsorship and payment. Airways allocate between civil and military on the "quantity of use" method, with the military share borne by general taxation. Highways are paid for entirely by fuel taxes and other user charges. Railways receive no subsidy, and now probably pay out relatively more in all kinds of taxes than other modes. In short, no agency has a formula specifically designed to calculate and economically justify Federal subsidy.

There is no indication in the agencies' material as to whether no consideration whatever was given to the problem of allocating some costs to the general public, or whether the problem was considered and it was decided that such allocations should be omitted. In large part, the historical development of agency programs, with their social and political backgrounds as embodied in their legislative histories, has tended to make them feel it would be somewhat academic to justify existing practices. In part, conscious concentration on cost-benefit analysis is a quite recent development and even later has been the development of the Planning-Programming-Budgeting System. However, it appears logical to infer that, if fairly clear rationale had been found by any agency to justify allocating some of its costs to the public benefit, sufficiently for explicit charge to public taxation, it would have found its way into a written methodology.

## APPENDIX 1

# DERIVATION OF ELASTICITY EFFECT EQUATION

The equation for traffic, fares, and the elasticity of demand, is:

$$\text{Traffic} = (\text{a constant}) \times (\text{Fares})^{\text{Elasticity}}$$

or $$T = aF^{E}$$

or $$\log T = A + E \log F$$

In calculating elasticity, we can usually start with percentages, as, before price changes, Traffic = 100.0 and Fares = 100.0; log T and log F are therefore each 2. The above equation then becomes

$$2. = A + 2.E$$

If $E = -1.28$ as computed by the CAB staff, then

$$2.00 = A - 2.56,$$

$$A = 4.56$$

$$\log T = 4.56 + E \log F$$

Similarly, the equation can be solved for any assumed value of E. Then, when we use the original equation, a fare increase of one percent makes $F = 1.01$, and a fare decrease of one percent makes $F = .99$. Solving the above equation for various elasticities, and assuming fare increases of 1, 2, 3, 4, and 5 percentage points, produce the following table of values by which to multiply traffic forecasts for assumed changes in fare levels:

### PERCENT RATIOS OF TRAFFIC

| Price Elasticity | Fare Increase of - | | | | | |
|---|---|---|---|---|---|---|
| | 0 | 1% | 2% | 3% | 4% | 5% |
| -1.0 | 100.00 | 99.01 | 98.04 | 97.09 | 96.15 | 95.24 |
| -1.28 | 100.00 | 98.80 | 97.48 | 96.29 | 95.10 | 93.95 |
| -1.5 | 100.00 | 98.52 | 97.07 | 95.66 | 94.29 | 92.94 |
| -1.6 | 100.00 | 98.42 | 96.88 | 95.38 | 93.92 | 92.49 |
| -2.0 | 100.00 | 98.03 | 96.12 | 94.26 | 92.46 | 90.70 |

## FORECAST METHODOLOGIES

We may make four main groupings of the methodologies in the literature of air traffic forecasting, as they relate to the place of price elasticity of demand in the overall approach. They are (1) those that specifically give weight to price elasticity of demand; and of those that do not do so, (2) those that project trends at assumed prices, (3) the theory of innovation cycles in the development of new aircraft, and (4) the analysis of the probable market, or "cell" theory.

(a) Specific weight to price elasticity of demand

(1) Bo Bjorkman[1] presents a large number of measurements of price elasticity of demand in markets within Europe and between Europe and the U.S. The elasticities range from .7 to 3.4 as follows: .7 for North Atlantic travel by European low-income passengers, 1.0 for North Atlantic travel by U.S. high-income passengers, 1.6 for traffic flows to and from Paris, and for a specific domestic Swedish market, 1.8 for another domestic Swedish market, 2.0 for still another, 2.2 for summer traffic to the central Mediterranean area, and for a domestic Danish market, 2.8 for North Atlantic travel by European high-income travelers, and 3.4 for a summer domestic Danish market -- a median value of about 1.9.

Bjorkman distinguishes four types of elasticity: the elasticity of total travel demand, within which air fare is a part; competitive elasticity, referring to the distribution of traffic between competing modes of transport; internal elasticity, referring to the distribution of air traffic by different classes and different fare categories; and income elasticity.

He also notes five cautions to be observed in analyzing elasticity of demand: allowance for a possible time lag which may be needed for the market to adjust to a new fare; allowance for the growth of traffic normally occurring for other reasons without any fare change; possible temporary capacity limitations when there is a sharp increase of traffic volume; changes in comfort or service that may accompany fare changes; and changes in fare structure where lowering the basic fare may radically affect the volume of use of previous special and promotional fares.

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[1] Bo Bjorkman, Methods of Research into the Elasticity of Demand of Air Transport, July 15, 1964.

He also states that basic fare changes in the order of magnitude of up to five percent may go practically unnoticed by the public. Since most annual fare changes are smaller than five percent, this suggests to us that there may be difficulties in statistically measuring close correlations of fare and traffic due to loose and sluggish reaction of potential travelers to small fare changes.

(2) Fred Turner, at SAAB in Sweden in 1962, made a study of U.S. development from 1947 to 1960.[2/] His conclusion was that price elasticity was -1.15, as compared to an income elasticity of 1.67 measured in GNP. This relationship is of the opposite order of importance of these two factors as found by the CAB staff (-1.28 for price elasticity and 1.16 for income elasticity, plus a trend variable although on a different basis of measurement).

(3) Wallace made a study of the 40 top city-pairs in the U.S. separated by 1500 miles or more.[3/] His findings were that 35 percent of the growth was accounted for by price decreases, 35 percent by service improvements such as faster flights and other advances, and 30 percent by growth in real per-capita income. However, in the top

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As quoted in Bjorkman above, and in Stephen Wheatcroft, Elasticity of Demand for North Atlantic Travel, a study made for the IATA, July 1964.

Dr. W. M. Wallace, The Demand for Airline Travel, for the Boeing Company, April 22, 1964.

twenty transcontinental city-pairs, his findings were that price decreases accounted for over 75 percent of the total traffic growth, that increased speed and non-stop range showed no effect in the formula, and that all non-price factors in total accounted for only 25 percent of the growth. These two results are difficult to reconcile, for if the twenty transcontinental city-pairs out of the aggregate showed such a high influence of price, then the others of the long-haul city-pairs must have showed a very much lower effect than the average of 35 percent growth due to fares.

(b) Trend Projections

(1) The CAB staff 1959 forecast used a statistical trend method.[4/] Fares were considered as a stated set of levels without specific weight given to the effect of price elasticity as such; it was assumed that both first-class and coach yields would remain at the 1958 level, and that the change in aggregate fare level would come only from the increased percentage of coach service.

The variables used were number of airline revenue passengers per 1000 U.S. population, number of airline miles flown per person, fare deflated by the Consumer Price Index, average fare of railroads (for, at that time, diversion of travel from rail to air was important), per-capita disposable personal income, and a net trend for the influence of safety, comfort, convenience, speed, schedule reliability, and other factors.

The CAB staff also noted a number of difficulties, in addition to the usual assumptions on future economic activity and possible wars: that the coming advent

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4/ U.S. Civil Aeronautics Board, Office of Carrier Accounts and Statistics, Research and Statistics Division. Forecast of airline passenger traffic in the United States: 1959-1965, December 1959.

of jets might constitute such a revolutionary change as to alter historical relationships; that if there were significant changes in airline fares they could have a large effect on traffic, and that judgment is involved in evaluating and selecting the factors to be considered in forecasting.

(2) LeFevre[5/] stated that transportation has grown in the long-term S-shaped Gompertz growth curve. He believes that the usual analysis relating transportation volume to any economic index such as GNP, by any type of regression trend, is in error. He concludes that there is no linear or other relationship over a long period of time. His theory is basically that the underlying factors cause growth of transportation in a practically invariable pattern of youth, maturity, and age, that each mode within the total follows this pattern, and that, as an inference, price as a separate factor other than what is inherent in the life-cycle of an industry, is of little independent effect.

(3) Craig[6/] tried several methods before confirming the cycle theory explained below. He worked out a relationship between GNP and passenger revenues, and forecast future traffic on the basis of assumed GNP growth, at a fixed fare level; then charted total intercity travel by all modes per unit of GNP; and then projected a second-degree curve of per capita expenditures for U.S. domestic airline travel to per capita GNP.

(4) Besse and Desmas[7/] reviewed a large number of methods used by U.S. and foreign forecasting methods. These included those used by airlines - Aer Lingus,

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[5/] William F. LeFevre. Determining Transportation Trends by the Gompertz Growth Curve.

[6/] Thomas R. Craig. The Outlook for the U.S. Domestic Airline Industry Through 1957. August 11, 1964.

[7/] G. Besse and G. Desmas. Forecasting for Air Transport - Methods and Results - Institut du Transport Aerien. 1966.

Air France, El Al, BEA, Canadian Pacific, MEA, Qantas, and United; manufacturers - Boeing, Douglas, Lockheed, Hawker-Siddeley; airports - Port of New York Authority, London, Amsterdam, Copenhagen, and North Rhine-Westphalia; and government and other bodies: CAB, European Civil Aviation Conference, and the Swedish Royal Board of Civil Aviation.

The methods covered a wide range of variables to be considered: economic factors included GNP, income, level of sales, imports and exports, number of private automobiles, money in circulation, population, number of families, regional growth rates, sociological data such as education and profession and so on, urbanization, population density, standard of living, ratio of people employed in services compared to total working population, etc; transportation factors used in various methodologies included average fares, surface and air fares, respective advantages of competing modes of transport, non-scheduled airline services, rate of penetration of air to surface, analysis of business and non-business travel separately, relative speed of air to surface, route structures, trends of income spent on air travel to total, introduction of new aircraft and surface transport equipment, facilities for tourists, convenience, speed, comfort, experience in air travel, ease of access to airports, degree of accessibility of surface transport, etc.

(c) The Cycle Theory

Analysts at The Boeing Company have developed a theory of aircraft innovation cycles.8/ It is basically that there has been a series of approximately nine-year cycles

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8/ William M. Wallace. An Analysis of the U.S. Domestic Air Travel Market 1926-1960 (with a forecast to 1967), and T.F. Comick and W.M. Don Wallace. Forecast of United States Domestic Airline Traffic 1961-1975. August 1961.

Air France, El Al, BEA, Canadian Pacific, MEA, Qantas, and United; manufacturers - Boeing, Douglas, Lockheed, Hawker-Siddeley; airports - Port of New York Authority, London, Amsterdam, Copenhagen, and North Rhine-Westphalia; and government and other bodies: CAB, European Civil Aviation Conference, and the Swedish Royal Board of Civil Aviation.

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8/ William M. Wallace. An Analysis of the U.S. Domestic Air Travel Market 1926-1960 (with a forecast to 1967), and T.F. Comick and W.M. Don Wallace. Forecast of United States Domestic Airline Traffic 1961-1975. August 1961.

of technological development in aircraft, within each of which there has been a repetitive pattern of traffic growth. The first phase was from 1927 to 1936, with an average annual growth rate of 67 percent, a second phase from 1937 to 1946 with a 34 percent annual rate of growth, and a third phase from 1948 to 1957 with a 17 percent annual growth rate. This theory forecast another cycle to 1967 with another halving of the previous cycle's annual rate of growth to between 8 and 9 percent, and then a fifth cycle beginning some time after 1967 with an annual rate of growth of about four percent.

The cyclical increases were attributed to a variety of expansion factors based on design innovations, such as long, medium, and short-range versions better adapted to new routes; tapping additional areas through new performance capabilities and better aircraft to appeal to the passenger market; and the development of aircraft that were larger and with more seats that were therefore more economical to operate and permitted lower real fares.

(d) The "Cell" Method

The Port of New York Authority is the leading advocate of a forecast methodology based upon market analysis and projection.[9] Their 1957 theory developed and projected the method, concluding that family income is the strongest single factor associated with differences in travel among individuals; that passenger age and family situation is an influence; that occupation is of weight; that most travel is by auto; that the choice of transport mode depends upon both distance to be traveled and number traveling together; and that most trips are for personal and pleasure reasons (although not by air). This method broke the entire travel market into 160 personal travel cells by age, occupation, income, and education, and into 130 business

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9/ The Port of New York Authority, Aviation Department, Forecast and Analysis Division. Forecast of the United States Domestic Air Passenger Market 1965-1975. January 1957; and Norman L. Johnson. Forecasting Airport Traffic. April 22-24, 1964.

travel cells by occupation, industry, and income. Personal travel was projected at a logarithmic rate by the reduction of non-fliers from 100 percent in 1935, to the percentage found in a 1955 survey, to 10 percent as a long-term minimum; business trips per 1000 were projected to increase at the annual 1935-1955 rate arithmetically into the future.

This method concludes that the relationship between air travel and basic economic indices is neither clear enough to be defined in specific quantitative terms, nor that past relationships even if definable can be assumed to continue indefinitely into the future. By contrast, it believes that the composition of the air travel market is extremely stable over a long period of time, and that projecting the cause-and-effect relationships of the characteristics of market segments within each "cell" will give a more reliable approach to air travel forecasting.

# CAB STAFF METHODOLOGY

## (a) The Formula

One of the greatest practical advantages of the CAB methodology for our purposes is that it gives explicit mathematical weight to the influence of price elasticity of demand. It produces three estimates of traffic volume, the values of which differ only because of different assumed airline passenger price levels. The three forecasts, extended to 1980 on the basis of computational factors furnished by the CAB staff beyond their published 1975 data, are as follows:

| Year | Billions of Revenue Passenger Miles<br>Forecast A | <br>Forecast B | <br>Forecast C |
|---|---|---|---|
| 1964 (actual) | 41.7 | 41.7 | 41.7 |
| 1970 | 62.5 | 69.2 | 75.7 |
| 1975 | 84.4 | 101.3 | 118.9 |
| 1980 | 111.0 | 143.1 | 180.0 |

The CAB staff considered a large number of factors with possible effects on air traffic forecasts:

> "The list of possible causes is impressively long: (1) the price of air passenger travel; (2) the prices of close substitutes for air passenger travel, and in fact, the prices of all other goods since the potential consumer of air travel must decide between purchasing air travel, some other good, or saving his money; (3) the level of income and wealth; (4) population, -- that is the number of potential air travelers in the right stage of the life cycle; (5) the quality of air transport service, that is, its speed, comfort, safety and convenience compared to alternative means of transportation and communication; (6) psychological attitudes toward air travel versus other means of travel, for example, fear of air travel; (7) consumer expectations as to future prices, etc.
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> "This list is far from complete. . ."[1/]

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[1/] U.S. Civil Aeronautics Board, Bureau of Accounts and Statistics, Research and Statistics Division. Forecasts of Passenger Traffic of the Domestic Trunk Air Carriers, Domestic Operations, Shceduled Service, 1965-1975. September 1965. pp.23-24.

As a result of examining these factors, the CAB staff decided that total revenue passenger miles in any year are determined by air fares, other consumer prices, income, population, and a trend representing all other factors.[2] They arrived at their final estimating equation by using multivariate regression analysis of data for these factors for the period 1947-1964, using year-to-year rates of changes in the logarithms of the factors.[3]

Obviously, intelligent use of these CAB estimates requires evaluation of all the assumptions and methodology. The three factors of primary importance are, of course, those appearing in the estimating equation. We will analyze each of them in turn. The others need not be examined in such detail.[4]

(b) Fare Levels

The three fare levels used by the CAB staff are:

Forecast A, which assumes that the total revenue passenger mile yield will increase just enough to offset increases in the Consumer Price Index, so that the yield will remain at the same level in terms of real purchasing power;

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[2] U.S. CAB, ibid., p. 24.

[3] The final equation used, with all factors expressed as annual first differences of the logarithms of the factors is:

Total revenue passenger miles per capita =

+ .085 (a constant)

- 1.28 Total passenger revenue per passenger mile, deflated by the Consumer Price Index

+ 1.16 Disposable personal income per capita deflated by the Consumer Price Index

- .048 Trend variable (for all other factors, using 1947 as 10, 1948 as 11, etc.)

The resultant figures are multiplied by estimated population to produce the final estimates.

[4] These include Consumer Price Index (1957-59 = 100), assumed to increase 1.5 points per year, and population forecast according to Series B, Current Population Reports, Series P-25, No. 286, U.S. Department of Commerce, Bureau of the Census, July 1964.

Forecast B, which assumes that the yield will not change, so that its price relative to the rest of the national economy will fall as the Consumer Price Index increases by 1.5 points per year for a total of 22.5 points from 1965 to 1980; and

Forecast C, which assumes that the yield will decline by 1.14 percent per year " -- the 1949-57 average."

It is these three different assumptions that make the 1980 estimates vary from 111.0 billion RPM for Forecast A, to 143.1 for Forecast B, to 180.0 for Forecast C. These large increases compare with actual 1964 traffic of 41.7 billion RPM.

First, it can be seen that with no reduction whatever in the real price of air transportation, the CAB method forecasts an increase of 166 percent by 1980. This sizable growth is due to the other factors in the CAB equation. Of the 16-year increase of 69 billion RPM, 26 billion is attributable to the "time trend," 25 billion to the increasing disposable personal income per capita, and 18 billion to growth in population.

The CAB staff makes no selection as to probable fare level and consequent probable forecast:

> "It will be noted that, although three alternative forecasts have been made, no one forecast has been singled out as the forecast 'most likely to succeed.' Each individual is thus free to 'pick the one he likes.' If he likes none of the assumptions, he can make his own, and using the equations, develop his own forecast."5/

At the outset of an analytical review, the fare level selected for Forecast C appears to include a major statistical improbability in its derivation. Although its stated basis appears reasonable: "Assumes Total RPM Yield will decline by 1.14 percent per year -- the 1949-57 average," its base does not in fact appear to be statistically probable.

The average trunkline yield per revenue passenger mile in 1949 was at a long-term high -- the highest between 1934 and

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5/ U.S. CAB, ibid., p. iii.

1959. By contrast, the 1957 yield was at an all-time low between the postwar year of 1947 and the present. Therefore, projecting a two-point trend line from a long-term peak down to a subsequent long-term trough appears to overstate the bounds of expected statistical probability.

In addition, the true trend of air passenger fares, even for the 1949-57 period, produces misleading implications when based on total domestic trunkline passenger revenues per passenger-mile. This is because the aggregate figures disregard the very important change in the "mix" of passenger traffic during the 1949-57 period. This is shown by the following figures:

| Year | Total Yield | First-Class Yield | Coach + Economy Yield |
|---|---|---|---|
| 1949 | 5.75¢ | 5.83¢ | 3.96¢ |
| 1957 | 5.25¢ | 5.89¢ | 4.25¢ |
| Percent Change | -8.7% | +1.0% | +7.3% |

Individually, each of the first-class and the coach + economy-class yields rose during the period. The aggregate, however, showed a decrease because of the pronounced relative shift of traffic from the higher-priced first-class traffic to the lower-priced coach + economy-class traffic, the latter rising sharply from 4 percent of the total RPM in 1949 to 39 percent in 1957.

If fare changes are brought up to the latest year available, 1965, they show an absolute increase in total yield (in terms of current dollars, not adjusted for general price levels of the Consumer Price Index) from both 1947 and 1957, and further shift of the coach percentage up to 75 percent of total domestic trunkline RPM:

| Year | Total Yield | First-Class Yield | Coach + Economy Yield |
|---|---|---|---|
| 1965 | 5.94¢ | 7.16¢ | 5.52¢ |
| Percent Change 1949-1965 | +3.3% | +22.8% | +39.4% |
| Percent Change 1957-1965 | +13.1% | +21.6% | +29.9% |

It would therefore appear to be undesirable, on a statistical basis of probability, and disregarding all other factors which might influence the possible changes in fare levels, to estimate fare levels on the basis of projecting as a long-term trend a straight line drawn from a unique peak to a unique trough.

Of course, as a practical matter, it would be logical to estimate future fares on the basis of estimated underlying economics of airline operation and the air travel market, difficult though that may be, rather than on the basis of any simple statistical projection.

(c) Disposable Personal Income

Another major problem with the CAB staff formula is that it assumes a straight-line relationship between Disposable Personal Income (DPI) per Capita and amount of air travel. DPI "measures the actual current income receipt of persons from all sources . . . net of taxes . . . [and] is the closest over-all statistical approximation to consumer purchasing power derived from current incomes."[6/]

DPI is spent on all types of consumer purchases. Its direct effect on air transportation, however, would not appear to be of a straight-line variety between rates of increase. As an

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[6/] U.S. Department of Commerce, Bureau of the Census. Historical Statistics of the United States, Colonial Times to 1957, A Statistical Abstract Supplement. Washington. D.C. U.S. Government Printing Office, 1960, p. 133.

illustration, let us take the DPI figures per capita used in the CAB forecasts, of $2,079 in 1964 and $2,561 in 1975.[7]

Since DPI goes for all expenditures, the great bulk of it must normally go for essential purchases such as food, clothing, and housing. In the above example, if it were to be assumed that $1,500 per year would be required for these necessities, then the amount left over for elective purchases including air travel would be some $500 in 1964 and $1,000 in 1975 -- a doubling during the 11-year period, rather than an increase of about 25 percent indicated by an assumed straight-line relationship to aggregate DPI. If the amount required for necessities were higher, as, for example, $1,800, then the increase in amount available for elective purchases would rise far more steeply, from some $200 to over $700 in the eleven years -- more than tripling. Of course, it is likely that the dollar amount for necessities would also rise over a longer period, without making allowance for Consumer Price Index increase in either case, but the basic economic logic appears to be the same -- that the percentage increases in the margin available for such elective purchases as air transportation can well go up very much more rapidly than simply in proportion to DPI per capita.

One possible objection to the use of such methodology is that it may be thought of as concerning personal travel alone, which accounts for only one-third of total domestic traffic. However, the relationship appears to be more important than that. It seems logical that the increasing amounts of income available for elective purchases -- including, but certainly not limited to, air transportation -- may very well be the major stimulant to our national economy during the long recent boom period. All industries and services of the business community are competing for the money available for these elective purchases, and business expansion and activity there-

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7/ U.S. CAB ibid, p. 13.

fore centers on such money. Air transportation, as one of the means by which businessmen go about their selling and planning for expanding and diversified markets, should therefore respond in its business-travel sector to the same quantitative influence that stimulates its personal/pleasure travel sector and the rest of the economy.

However, making specific forecasts using the above DPI logic would require a considerable amount of research, including the measurement of what general levels of income are required for "necessities," how much would consequently be available for elective purchases, and how much of the resultant would probably be spent for air transportation. Unfortunately, the time and effort limitations of the present study do not allow for the necessarily extensive and intensive investigation. Pending any valid research of this type, we will therefore have to make judgmental adjustments in the initial starting point for our estimates that do not include the more logical relationship of DPI to air traffic.

### (d) Base for Statistical Projections

All statistical methods used in forecasting contain inherent problems, and their consequent errors are magnified, of course, as any assumed trend is projected further and further into the future.

For example, the very mechanics of selecting a base period for any statistical comparison influence the subsequent forecast. The CAB staff report states in one place (on page 24) that the base period used was 1947-1964, and in another place (on page 31) that the base period used was one year longer, 1946-1964 -- apparently a negligible difference. But the annual rate of increase for the 18-year period was 11.5 percent, and for the 17-year period it was 12.1 percent. If these compound rates of interest are projected from 1965 to 1980, then the 18-year basis shows an estimated increase in traffic of 5.12 times, and the 17-year basis shows an increase of 5.55 times -- a difference of over 8 percent.

It has also been suggested that the advent of the jets may have produced a structural change in the air passenger market, and that the true trend line should be recomputed on a base beginning about 1960 when jets had come into general use. If this were done, the 1960-1965 trend would show an annual rate of increase of 13.5 percent; projecting it to 1980 would produce an estimate equal to 6.68 times the 1965 traffic -- a difference over the 1946-1964 projection of more than 30 percent.

(e) Airline Fare and Profit Policies

One major factor makes it appear dubious that without strong external influence, such as by the CAB, there will necessarily be a long-term decrease in airline fare levels -- the probable financial effect of fare cuts on the airlines. Even assuming a price elasticity of demand for air travel such as estimated by the CAB staff, it seems likely that the airlines, based on the normal American business tendency to try to maximize profit, would resist lowering their fares (insofar as concerns price elasticity only, and not as a result of possible reduced costs where prices could then be cut without reducing profit margins).

As an illustration, assume that the current CAB staff estimate of -1.28 is correct for air travel price elasticity. Assume that 10,000 passengers are moving in a market at a $100 fare, producing a gross revenue of $1,000,000. If fares were to be reduced by 10 percent to $90, then traffic with the above price elasticity would increase by 13.7 percent to 13,700, to produce a gross revenue of $1,023,300.

Under most circumstances, it is unlikely that any airline could handle 13.7 percent more traffic with an added cost of only 2.3 percent, except on the most special and short-term basis. Unless the fare is highly selective, or the existing load factor is very low, any substantial increase in traffic requires an increase, not only in direct passenger-handling costs such as reservations and food, but also in the longer run in total capacity provided. Whenever this is so, the airline will not freely elect fare reductions as a profit-maximizing move.

As an assumption on the opposite side, assume that the airline were to raise fares by 10 percent. In such event, at the same elasticity, traffic would decline by 11.5 percent and gross revenues would decrease by 2.6 percent. If traffic were increasing for other reasons, such as progressively higher consumer incomes, and leaving aside such factors as competitive maneuvers and CAB pressures, it would normally be more profitable for an airline to handle 11.5 percent fewer passengers at a cost decrease of only 2.6 percent.

Of course, the economic motivations of the airlines are much stronger against price decreases than for price increases. Airlines, like most businesses, do not like to contemplate volume decreases, even with some probability that profit margins would increase -- the competitive dangers of volume decline appear too great. In addition, real airline costs do not in fact decrease proportionately with declines in traffic, and the theoretical profit potentialities are largely in mathematical assumption and accounting allocation rather than in practical reality.

Even at higher price elasticities, it seems likely that the basic economic motivations would be the same, although not of the same magnitude. At a price elasticity of -2.0, for example, a 10 percent fare reduction would result in a traffic increase of 23.5 percent and an increase in gross revenues of 11.2 percent; again, it is doubtful whether under most circumstances airlines could handle traffic volumes growing at twice the rate of revenues available. Even at a price elasticity of -3.0, at a 10 percent fare cut, the resulting increase of 37.2 percent in traffic would have to be accomplished within a revenue increase of 23.5 percent.

APPENDIX 4

## U. S. SCHEDULED INTERNATIONAL AND TRUNK PASSENGER TRAFFIC

Revenue Passenger-Miles)
(Millions

| Year | International and Territorial | Domestic Trunk | Percent International to Domestic |
|---|---|---|---|
| 1955 | 4,499 | 19,206 | 23.4% |
| 1956 | 5,226 | 21,643 | 24.1 |
| 1957 | 5,882 | 24,500 | 24.0 |
| 1958 | 6,124 | 24,436 | 25.1 |
| 1959 | 7,064 | 28,127 | 25.1 |
| 1960 | 8,306 | 29,233 | 28.4 |
| 1961 | 8,769 | 29,535 | 29.7 |
| 1962 | 10,138 | 31,828 | 31.9 |
| 1963 | 11,905 | 36,384 | 32.7 |
| 1964 | 14,352 | 41,658 | 34.5 |
| 1965 | 16,789 | 48,987 | 34.3 |
| 1970 | 30,000 | 76,200 | 39.3 |
| 1975 | 47,400 | 116,200 | 40.8 |
| 1980 | 72,100 | 168,400 | 42.8 |

## GENERAL AVIATION AIRCRAFT
## AND HOURS FLOWN BY TYPE OF FLYING

| | Business | Commercial | Personal | In-structional | Other | Total |
|---|---|---|---|---|---|---|
| **Number of Aircraft** | | | | | | |
| 1954 | 18,570 | 7,850 | 29,350 | 4,720 | 690 | 61,180 |
| 1964 | 21,127 | 11,979 | 46,721 | 6,855 | 2,060 | 88,742 |
| Annual % Increase | 1.3 | 4.3 | 4.8 | 3.5 | 11.6 | 3.8 |
| 1970 | 26,220 | 16,610 | 66,170 | 10,340 | 2,530 | 121,870 |
| 1975 | 32,150 | 21,850 | 88,450 | 14,550 | 3,000 | 160,000 |
| 1980 | 38,930 | 28,690 | 118,370 | 20,500 | 3,560 | 210,050 |
| Annual % Increase | 3.9 | 5.6 | 6.0 | 7.1 | 3.5 | 5.5 |
| **Hours Flown (000)** | | | | | | |
| 1954 | 3,875 | 1,754 | 1,920 | 1,292 | 47 | 8,888 |
| 1964 | 5,869 | 3,317 | 3,792 | 2,588 | 172 | 15,738 |
| Annual % Increase | 4.2 | 6.6 | 7.0 | 6.5 | 13.9 | 5.9 |
| 1970 | 7,690 | 4,890 | 5,530 | 3,990 | 211 | 22,311 |
| 1975 | 9,670 | 6,760 | 7,570 | 5,700 | 250 | 29,950 |
| 1980 | 12,110 | 9,350 | 10,370 | 8,180 | 300 | 40,310 |
| Annual % Increase | 4.6 | 6.7 | 6.5 | 7.5 | 3.5 | 6.0 |

APPENDIX 5

## DIRECT OPERATING COSTS PER AIRCRAFT MILE, 1956-1965
## TOTAL CERTIFICATED ROUTE CARRIERS

| | Revenue Aircraft Miles (000) | Flying Operations (000) | Per Aircraft Mile | Direct Maintenance (000) | Per Aircraft Mile | Depreciation Flight Equipment (000) | Per Aircraft Mile |
|---|---|---|---|---|---|---|---|
| 1956 | 869,314 | $ 532,981 | $.61 | $227,838 | .26 | $133,347 | .15 |
| 1957 | 976,169 | 659,341 | .67 | 235,464 | .24 | 188,809 | .19 |
| 1958 | 972,987 | 670,099 | .69 | 248,412 | .26 | 181,319 | .19 |
| 1959 | 1,030,242 | 752,249 | .73 | 301,898 | .29 | 211,380 | .21 |
| 1960 | 997,975 | 812,152 | .81 | 329,864 | .33 | 256,523 | .26 |
| 1961 | 969,556 | 858,328 | .88 | 330,231 | .34 | 336,545 | .35 |
| 1962 | 1,009,784 | 896,319 | .89 | 372,097 | .37 | 325,667 | .32 |
| 1963 | 1,095,058 | 949,417 | .87 | 385,450 | .35 | 339,605 | .31 |
| 1964 | 1,189,135 | 1,029,893 | .87 | 442,592 | .37 | 314,442 | .26 |
| 1965 | 1,353,499 | 1,157,808 | .85 | 503,857 | .37 | 348,245 | .26 |

SOURCE: Air Carrier Financial and Traffic Statistics, U.S. C.A.B.

# FORECAST OF FLYING OPERATIONS COSTS
# LONG RANGE JET AIRCRAFT
## DC-8/B-707 Types

| | Cents per Aircraft Mile | | | |
|---|---|---|---|---|
| | 1965 Actual[1/] | 1970 | 1975 | 1980 |
| Crew | 32¢ | 37¢ | 43¢ | 51¢ |
| Fuel, Oil and Taxes | 44 | 47 | 51 | 55 |
| Insurance | 2.5 | 2.5 | 2.5 | 2.5 |
| Maintenance - Labor | 11 | 13 | 15 | 17 |
| Maintenance - Materials | 19 | 22 | 25 | 29 |
| Maintenance - Burden | 20 | 22 | 24 | 27 |

---

1/ Source: Air Carrier Financial and Traffic Statistics, U.S.C.A.B.

## NOTES

For purposes of this report, the present family of long-range jet aircraft, comprised almost entirely of DC-8's and Boeing 707's in their various series, is used as a composite, since variations in unit operating costs are relatively minor. The base data are derived from operations for the calendar year 1965 and are projected individually for three future years studied.

### Crew

Reference here is to operating or cockpit crew. World-wide shortages of trained transport pilots will undoubtedly continue to solidify the strong bargaining position of the crew unions, and this cost, on an aircraft revenue mile basis, will trend upward.

This will not necessarily be attributable to changes in basic rates of compensation; instead, pressures will more likely be brought to bear upon revisions of the already-complex work rules, so that a smaller number of productive flight hours will be performed for similar or slightly higher annual payments. This will have the effect of requiring a greater number of personnel to perform a given flight program, increasing the effect of labor shortages, and increasing crew costs for the foreseeable future.

Standard crew contracts already contain provisions for this kind of labor inflation; duty rig schedule compliance premiums, day-and-night differentials, rest requirements, training assignments and rigid seniority rules will become increasingly important in setting the relationship between wage levels and productive time. An average increase of 3% per year is applied in this analysis.

### Fuel and Oil

Although modern aircraft consume a substantially cheaper fuel than gasoline, and the fan power plant is more efficient than the early families of jet engines, the increasing demand for turbine fuel will undoubtedly cause some price increases as the fuel producers' capacities are expanded. Such price changes will in part be offset by greater efficiency in cruise control and by wider availability of fuel at smaller airports, which presently demand higher per-gallon prices. Without reference to additional fuel-tax possibilities, a modest increase in fuel cost can be anticipated, amounting to approximately 1½% per year.

Insurance

Only a small portion of this cost varies with activity, the liability coverage for passengers and third parties, the total cost of which is low. The largest item of insurance is hull coverage. With the decline in aircraft accidents per mile of flight exposure, it is possible that this unit cost will decline. For the present analysis, however, it is assumed that general inflation will absorb the bulk of such possible declines, and the current rates per aircraft mile are used throughout the period in question.

Maintenance

It is in this area of cost that a number of potentially offsetting factors exist. On the one hand, there will be continuing pressures for unit wage increases, at least to the extent of whatever "guidelines" may from time to time be suggested. These pressures will apply both to carrier personnel and to the labor force of contracting or factory overhaul organization. Around-the-clock operations in many airlines will increase shift differentials and overtime. Increasing trends to specialization in line maintenance shops will tend to increase the numbers of personnel on permanent payroll. This combination of factors, on the basis of past experience, could be expected to increase maintenance costs by some 5-6% per year.

On the other hand, experience has shown that jet aircraft, and particularly their engines, have a higher degree of reliability than was true of previous equipment. Time-between-overhauls has increased steadily on an industry-wide basis, and every such extension of course reduces cost-per-mile, even though the unit price of an overhaul may increase. Many of the operating systems are simpler in mechanism and design, and even such factors as vibration fatigue have been reduced.

For these reasons, the trend in wage rates and materials cost is dampened in part, and a 3% annual increase is projected. Since indirect maintenance, or burden, tends to increase less rapidly than does direct, a 2% annual increase is applied to this category of cost.

# FORECAST OF FLYING OPERATIONS COSTS
## SHORT RANGE JET AIRCRAFT
## DC-9/B-727, 737 Types

| | Cents per Aircraft Mile | | | |
|---|---|---|---|---|
| | 1965 Actual[1] | 1970 | 1975 | 19[illegible] |
| Crew | 32¢ | 37¢ | 43¢ | 51¢ |
| Fuel, Oil and Taxes | 31 | 33 | 35 | 38 |
| Insurance | 1.5 | 1.5 | 1.5 | 1.5 |
| Maintenance - Labor | 8 | 9 | 11 | 13 |
| Maintenance - Materials | 14 | 16 | 19 | 22 |
| Maintenance - Burden | 14 | 15 | 17 | 19 |

## NOTES

The percentage cost increases projected here are the same as those described in the Notes to Appendix 6B.

Although other aircraft are already in use on the short-to-medium stage lengths, data for the DC-9 are used herein as being approximately representative of this family of aircraft.

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[1] Source: Air Carrier Financial and Traffic Statistics, U.S.C.A.B.

# FORECAST OF FLYING OPERATIONS COSTS
# STRETCHED JET AIRCRAFT
# DC-8-60 Types

| | Cents per Aircraft Mile | | |
|---|---|---|---|
| | 1970 | 1975 | 1980 |
| Crew | 39¢ | 45¢ | 52¢ |
| Fuel, Oil and Taxes | 54 | 58 | 63 |
| Insurance | 3 | 3 | 3 |
| Maintenance - Labor | 15 | 17 | 20 |
| Maintenance - Materials | 25 | 29 | 34 |
| Maintenance - Burden | 25 | 27 | 30 |

## NOTES

The percentage cost increases projected here are the same as those described in the Notes to Appendix 6B.

None of the stretched jets is yet in operation. Accordingly, manufacturer's estimates are relied upon for the differentials between these aircraft and the current DC-8 families. These differentials have been estimated as follows:

| | |
|---|---|
| Crew | - 5% above DC-8, primarily for gross weight difference |
| Fuel | - 15%, drag compensation |
| Insurance | - Higher base premiums |
| Maintenance | - 15% |

APPENDIX 6E

# FORECAST OF FLYING OPERATIONS COSTS

## B-747 Types

| | Cents per Aircraft Mile | | |
|---|---|---|---|
| | 1970 | 1975 | 1980 |
| Crew | 41¢ | 48¢ | 56¢ |
| Fuel, Oil and Taxes | 89 | 96 | 103 |
| Insurance | 6.5 | 6.5 | 6.5 |
| Maintenance - Labor | 25 | 29 | 34 |
| Maintenance - Materials | 43 | 50 | 58 |
| Maintenance - Burden | 43 | 47 | 52 |

## NOTES

The percentage cost increases projected here are the same as those described in the Notes to Appendix 6B. The B-747 aircraft are expected to be operating in 1971.

Manufacturer's estimates are used for establishing the differentials between these aircraft and the current jet families. The following are the differentials used:

Crew - 8% above DC-8, primarily for gross weight difference

Fuel - 90% above DC-8

Insurance - Higher base premiums

Maintenance - 90% above DC-8/B-707

APPENDIX 6F

## FORECAST OF FLYING OPERATIONS COSTS
## TURBO-PROP AIRCRAFT
## CV-600/F-27 Types

| | Cents per Aircraft Mile | | | |
|---|---|---|---|---|
| | 1965 Actual[1] | 1970 | 1975 | 198 |
| Crew | 19¢ | 22¢ | 26¢ | 31¢ |
| Fuel, Oil and Taxes | 16 | 17 | 18 | 20 |
| Insurance | 1.5 | 1.5 | 1.5 | 1. |
| Maintenance - Labor<br>Maintenance - Materials | 20 | 23 | 27 | 31 |
| Maintenance - Burden | 15 | 16 | 18 | 20 |

### NOTES

The local service carriers will probably retain certain turbo-prop aircraft in service through 1980 as a supplement to jet fleets. Since the upward pressure of wages and material costs will be generally applicable, the same percentage increases as are described in the Notes to Appendix 6B are applied.

Base data are from 1965 actual figures, representing a composite of the Convair 580 and 600 conversions and the F-27 aircraft already in service.

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[1] Source: Air Carrier Financial and Traffic Statistics, U.S.C.A.

APPENDIX 6G

## FORECAST OF FLYING OPERATIONS COSTS
## PISTON AIRCRAFT
### Convair and DC-3 Types

| | Cents per Aircraft Mile | |
|---|---|---|
| | 1965<br>Actual | 1970 |
| Crew | 23¢ | 26¢ |
| Fuel | 19 | 20 |
| Insurance | 1.25 | 1.25 |
| Maintenance - Direct | 26 | 30 |
| Maintenance - Burden | 12 | 13 |

### NOTES

It is assumed for purposes of this analysis that all piston ircraft will be retired from scheduled service between 1970 and 975. For the 1970 period, the cost increases are the same perentages described in the Notes to Appendix 6B.

1965 base data are for the Convair 240, which is an approxiate average of the Martin, Convair and Douglas aircraft still in peration.

# PAST TRENDS IN PASSENGER SERVICE COSTS PER REVENUE PASSENGER MILE

| | Domestic Trunks | | | Local Service | | | International | | |
|---|---|---|---|---|---|---|---|---|---|
| | Revenue Passenger Miles | $ (000) | Per Revenue Passenger Mile | Revenue Passenger Miles | $ (000) | Per Revenue Passenger Mile | Revenue Passenger Miles | $ (000) | Per Revenue Passenger Mile |
| 1957 | 24,499,510 | $ 95,504 | .390¢ | 747,288 | $ 4,027 | .539¢ | 5,882,036 | $ 34,075 | .579¢ |
| 1958 | 24,435,657 | 101,222 | .414 | 820,192 | 4,529 | .552 | 6,123,948 | 37,080 | .604 |
| 1959 | 28,127,216 | 130,942 | .465 | 1,024,336 | 6,078 | .594 | 7,064,211 | 44,287 | .627 |
| 1960 | 29,233,199 | 150,356 | .514 | 1,141,593 | 7,183 | .629 | 8,306,348 | 48,271 | .581 |
| 1961 | 29,534,792 | 156,810 | .531 | 1,343,761 | 8,389 | .624 | 8,768,501 | 53,637 | .612 |
| 1962 | 31,827,840 | 164,546 | .517 | 1,607,673 | 9,726 | .605 | 10,137,777 | 57,794 | .570 |
| 1963 | 36,383,756 | 179,890 | .494 | 1,868,988 | 10,660 | .570 | 11,905,430 | 70,380 | .591 |
| 1964 | 41,658,368 | 213,988 | .514 | 2,244,488 | 11,739 | .523 | 14,352,393 | 80,165 | .559 |
| 1965 | 48,986,972 | 266,279 | .544 | 2,621,289 | 13,426 | .512 | 16,789,044 | 100,295 | .597 |

SOURCE: Air Carrier Financial and Traffic Statistics, U.S. C.A.B.

APPENDIX 6I

## FORECAST OF PASSENGER SERVICE COSTS PER REVENUE PASSENGER MILE

| Per Revenue Passenger Mile | Base 1965 | 1970 | 1975 | 1980 |
|---|---|---|---|---|
| Domestic Trunk Carriers | .5¢ | .54¢ | .57¢ | .61¢ |
| Local Service Carriers | .5¢ | .53¢ | .56¢ | .58¢ |
| International Carriers | .6¢ | .63¢ | .67¢ | .70¢ |

## NOTES

Although this is an area where competition can theoretically best be exercised, and consequently where cost increases might best be applied to lure the passenger from a competing service, as a practical proposition there are limits in actual service performance. The bulk of the appeal will probably be through advertising and promotion, which are discussed elsewhere. Variations in numbers of cabin attendan's or in meal quality will produce only modest changes in plane-mile costs, and ground service if anything may decline in cost with increasing use of electronic equipment for confirmations, reservations and baggage handling. An increase of only 1% per year per revenue passenger mile appears adequate to cover this category of cost.

APPENDIX 6J

## PAST TRENDS IN AIRCRAFT AND TRAFFIC SERVICING COSTS PER REVENUE TON MILE

| | Trunks | | | Locals | | | International | | |
|---|---|---|---|---|---|---|---|---|---|
| | Revenue Ton Miles (000) | $ (000) | Per Revenue Ton Mile | Revenue Ton Miles (000) | $ (000) | Per Revenue Ton Mile | Revenue Ton Miles (000) | $ (000) | Per Revenue Ton Mile |
| 1957 | 2,713,703 | $217,210 | $.080 | 76,795 | $21,161 | $.275 | 826,298 | $ 72,904 | $.0882 |
| 1958 | 2,738,947 | 213,109 | .084 | 84,393 | 24,047 | .285 | 866,847 | 79,610 | .0918 |
| 1959 | 3,153,501 | 275,301 | .087 | 105,759 | 31,185 | .295 | 1,003,144 | 88,078 | .0878 |
| 1960 | 3,313,515 | 305,674 | .092 | 118,413 | 36,492 | .308 | 1,184,190 | 102,184 | .0863 |
| 1961 | 3,418,946 | 328,302 | .096 | 140,344 | 42,368 | .301 | 1,308,452 | 108,094 | .0826 |
| 1962 | 3,748,364 | 362,912 | .097 | 168,489 | 48,095 | .285 | 1,546,794 | 116,893 | .0755 |
| 1963 | 4,233,337 | 394,180 | .093 | 196,248 | 53,143 | .270 | 1,779,045 | 127,580 | .0717 |
| 1964 | 4,883,556 | 425,197 | .087 | 236,435 | 59,053 | .249 | 2,130,866 | 148,012 | .0694 |
| 1965 | 5,818,136 | 483,429 | .083 | 278,113 | 66,346 | .240 | 2,682,328 | 170,196 | .0637 |

SOURCE: Air Carrier Financial and Traffic Statistics, U.S.C.A.B.

APPENDIX 6K

## FORECAST OF AIRCRAFT AND TRAFFIC SERVICING COSTS PER REVENUE TON MILE

| Per Revenue Ton Mile | Base 1965 | 1970 | 1975 | 1980 |
|---|---|---|---|---|
| Domestic Trunk Carriers | 8¢ | 9.6¢ | 11.5¢ | 13.8¢ |
| Local Service Carriers | 24¢ | 17¢ | 16¢ | 15 |
| International Carriers | 6¢ | 7.2¢ | 8.6¢ | 10.3¢ |

### NOTES

Although there are certain areas in this cost category where reductions may be anticipated, such as increasing use of programming for dispatch and aircraft routing, they are more than offset by anticipated increases in airport costs. In addition to the higher landing fees which will be charged for heavier equipment, the costs of airport improvement must in part be passed along to the air carriers. With the airport development programs now in place and planned for the foreseeable future, an increase from 1965 levels of 20% for each five-year period through 1980 is believed to be a reasonable estimate for trunk and international carriers.

The local service operations have been excessively high-cost, due to frequent landings, relatively low traffic density, and generally high production per revenue ton mile. It appears that the projected traffic increases will cause this unit cost to decline, especially in response to the transition to more productive equipment.

## DISTRIBUTION OF CARRIAGE OF FORECASTED CARGO
(Millions of Ton-Miles)

| | Total | Combination Aircraft | All-Cargo Aircraft |
|---|---|---|---|
| Domestic Cargo: | | | |
| 1970 | 3,861 | 1,930 | 1,931 |
| 1975 | 7,924 | 3,962 | 3,962 |
| 1980 | 14,670 | 7,335 | 7,335 |
| International Cargo: | | | |
| 1970 | 2,490 | 1,245 | 1,245 |
| 1975 | 5,317 | 2,658 | 2,659 |
| 1980 | 10,328 | 5,164 | 5,164 |
| Local Service Cargo: | | | |
| 1970 | 73.0 | 73.0 | - |
| 1975 | 191.6 | 191.6 | - |
| 1980 | 502.9 | 502.9 | - |

NOTE: This distribution is based on past records, which show that approximately 50% of the air cargo in a given market will move by combination aircraft, so long as belly-compartment space is available, and that the remaining 50% will move by all-cargo aircraft, for reasons of size, density, or other factors.

The exception made is with the local carriers, who will operate far more than sufficient capacity to carry the tonnage in combination aircraft, and whose operating frequencies would justify only minimal all-cargo service.

# FORECAST OF TRAFFIC, CAPACITY AND PASSENGER REVENUES
## DOMESTIC TRUNK CARRIERS

| | 1970 | 1975 | 1980 |
|---|---|---|---|
| Revenue Passenger Miles (billions) | 76.2 | 116.2 | 168.4 |
| Estimated Load Factor | 50% | 52% | 53% |
| Available Seat Miles Required (billions) | 152.4 | 223.4 | 317.7 |
| Offered Seat Miles (millions)[1] | 151,000 | 223,167 | 315,966 |
| Computed Load Factor | 50.4% | 52.0% | 53.2% |
| Yield per Passenger Mile[2] | 5.85 | 5.77 | 5.68 |
| Passenger Revenue (millions) | $4,458 | $6,705 | $9,565 |

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[1] Appendix 8C.

[2] Appendix 8B.

## TREND AND FORECAST OF PASSENGER YIELD
## DOMESTIC TRUNK CARRIERS

Percent Tourist/Economy of Total Revenue Passenger Miles:[1/]

| | |
|---|---|
| 1955 | 35.0 |
| 1956 | 37.3 |
| 1957 | 38.7 |
| 1958 | 41.1 |
| 1959 | 43.6 |
| 1960 | 49.2 |
| 1961 | 57.8 |
| 1962 | 65.6 |
| 1963 | 67.6 |
| 1964 | 71.9 |
| 1965 | 74.6 |

Forecast of Traffic Mix and Composite Yield:

| | Per Passenger Mile | | | |
|---|---|---|---|---|
| | First Class Yield | Tourist/ Economy Yield | Tourist Percent of Total | Weighted Average Yield |
| 1965 (Actual) | 7.16¢ | 5.52¢ | 74.6% | 6.01¢ |
| 1970 | 7.16¢ | 5.52¢ | 80% | 5.85 |
| 1975 | 7.16¢ | 5.52¢ | 85% | 5.77 |
| 1980 | 7.16¢ | 5.52¢ | 90% | 5.68 |

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[1/] SOURCE: Handbook of Airline Statistics, U.S.C.A.B.

FORECAST OF CAPACITY REQUIREMENTS

DOMESTIC TRUNK CARRIERS

| Aircraft Families | Daily Utili-zation (Hours) | Average Speed (MPH) | Annual Hours Per Aircraft | Annual Miles Per Aircraft (000) | Average Seating Capacity | Annual Available Seat Miles Per Aircraft (000) | Estimated Number of Aircraft | Total Annual Available Seat Miles (000,000) | Total Annual Aircraf Miles (000) |
|---|---|---|---|---|---|---|---|---|---|
| 1970 | | | | | | | | | |
| DC-8/B-707 | 10 | 480 | 3,650 | 1,752 | 120 | 210,240 | 400 | 84,096 | 700,800 |
| DC-9/B-727,737 | 8.5 | 380 | 3,102 | 1,179 | 90 | 106,106 | 500 | 53,052 | 589,500 |
| DC-8-60 Series | 11 | 500 | 5,500 | 2,008 | 230 | 461,725 | 30 | 13,852 | 60,240 |
| Total | | | | | | | | 151,000 | |
| 1975 | | | | | | | | | |
| DC-8/B-707 | 10 | 480 | 3,650 | 1,752 | 120 | 210,240 | 400 | 84,096 | 700,800 |
| DC-9/B-727,737 | 8.5 | 380 | 3,102 | 1,179 | 90 | 106,106 | 600 | 63,663 | 707,400 |
| DC-8-60 Series | 11 | 500 | 5,500 | 2,008 | 230 | 461,725 | 65 | 30,012 | 130,520 |
| B-747 | 11.5 | 515 | 4,197 | 2,162 | 350 | 756,599 | 60 | 45,396 | 129,720 |
| Total | | | | | | | | 223,167 | |
| 1980 | | | | | | | | | |
| DC-8/B-707 | 10 | 480 | 3,650 | 1,752 | 120 | 210,240 | 400 | 84,096 | 700,80 |
| DC-9/B-727, 737 | 8.5 | 380 | 3,102 | 1,179 | 90 | 106,106 | 750 | 79,579 | 884,21 |
| DC-8-60 Series | 11 | 500 | 5,500 | 2,008 | 230 | 461,725 | 125 | 57,716 | 250,93 |
| B-747 | 11.5 | 515 | 4,197 | 2,162 | 350 | 756,599 | 125 | 94,575 | 270,21 |
| Total | | | | | | | | 315,966 | |

## ESTIMATE OF FLIGHT EQUIPMENT VALUE AND DEPRECIATION EXPENSE
## DOMESTIC TRUNK CARRIERS

| | Average Initial Price (Millions) | Annual Depreciation Per Unit | Average Years Depreciated by 1970 | Net Book Value 1970 (000) | Deprecia Expens 1970 |
|---|---|---|---|---|---|
| DC-8 Type - 400 Aircraft | $ 8.0 | $ 566,667 | 5 | $2,066,666 | $226,666 |
| DC 9 Type - 500 Aircraft | 4.75 | 336,460 | 2 | 2,038,540 | 168,230 |
| Stretch Type - 30 Aircraft | 11.0 | 779,167 | 1 | 306,625 | 23,375 |
| 1970-1975 Acquisitions | | | | | |
| DC-8 Replacements - 100 Aircraft | 8.0 | 566,667 | | | |
| DC-9 Type - 100 Aircraft | 5.0 | 354,330 | | | |
| Replacements - 50 Aircraft | 5.0 | 354,330 | | | |
| Stretch Type - 35 Aircraft | 11.0 | 779,167 | | | |
| Jumbo Type - 60 Aircraft | 22.8 | 1,615,000 | | | |
| 1975-1980 Acquisitions | | | | | |
| DC-8 Replacements - 300 Aircraft | 8.0 | 566,667 | | | |
| DC-9 Type - 150 Aircraft | 5.0 | 354,330 | | | |
| Replacements - 100 Aircraft | 5.0 | 354,330 | | | |
| Stretch Type - 60 Aircraft | 11.0 | 779,167 | | | |
| Jumbo Type - 65 Aircraft | 22.8 | 1,615,000 | | | |
| Net Investment - Flight Equipment (000) | | | | $4,411,831 | |
| Depreciation - Flight Equipment | | | | | $418,271 |

## ESTIMATE OF FLIGHT EQUIPMENT VALUE AND DEPRECIATION EXPENSE

## DOMESTIC TRUNK CARRIERS

| | Average Initial Price (Millions) | Annual Depreciation Per Unit | Average Years Depreciated by 1975 | Net Book Value 1975 (000) | Deprecia Expens 1975 |
|---|---|---|---|---|---|
| DC-8 Type - 400 Aircraft | $ 8.0 | $ 566,667 | 10 | $ 933,332 | $226,666 |
| DC-9 Type - 500 Aircraft | 4.75 | 336,460 | 7 | 1,197,390 | 168,230 |
| Stretch Type - 30 Aircraft | 11.0 | 779,167 | 6 | 189,750 | 23,375 |
| 1970-1975 Acquisitions | | | | | |
| DC-8 Replacements - 100 Aircraft | 8.0 | 566,667 | 2 | 686,667 | 56,666 |
| DC-9 Type - 100 Aircraft | 5.0 | 354,330 | 2 | 429,134 | 35,433 |
| Replacements - 50 Aircraft | 5.0 | 354,330 | 2 | 214,913 | 17,716 |
| Stretch Type - 35 Aircraft | 11.0 | 779,167 | 2 | 330,458 | 27,270 |
| Jumbo Type - 60 Aircraft | 22.8 | 1,615,000 | 2 | 1,174,200 | 96,900 |
| 1975-1980 Acquisitions | | | | | |
| DC-8 Replacements - 300 Aircraft | 8.0 | 566,667 | | | |
| DC-9 Type - 150 Aircraft | 5.0 | 354,330 | | | |
| Replacements - 100 Aircraft | 5.0 | 354,330 | | | |
| Stretch Type - 60 Aircraft | 11.0 | 779,167 | | | |
| Jumbo Type - 65 Aircraft | 22.8 | 1,615,000 | | | |
| Net Investment - Flight Equipment (000) | | | | $5,155,844 | |
| Depreciation - Flight Equipment | | | | | $652,25 |

# ESTIMATE OF FLIGHT EQUIPMENT VALUE AND DEPRECIATION EXPENSE

## DOMESTIC TRUNK CARRIERS

| | Average Initial Price (Millions) | Annual Depreciation Per Unit | Average Years Depreciated by 1980 | Net Book Value 1980 | Depreciation Expense 1980 |
|---|---|---|---|---|---|
| DC-8 Type - 400 Aircraft | $ 8.0 | $ 566,667 | Fully | 0 | 0 |
| DC-9 Type - 500 Aircraft | 4.75 | 336,460 | Fully | 249,375 | 0 |
| Stretch Type - 30 Aircraft | 11.0 | 779,167 | 11 | 72,875 | $ 23,375,010 |
| 1970-1975 Acquisitions | | | | | |
| DC-8 Replacements - 100 Aircraft | 8.0 | 566,667 | 7 | 403,333 | 56,666,700 |
| DC-9 Type - 100 Aircraft | 5.0 | 354,330 | 7 | 251,967 | 35,433,000 |
| Replacements - 50 Aircraft | 5.0 | 354,330 | 7 | 125,833 | 17,716,500 |
| Stretch Type - 35 Aircraft | 11.0 | 779,167 | 7 | 194,104 | 27,270,845 |
| Jumbo Type - 60 Aircraft | 22.8 | 1,615,000 | 7 | 689,700 | 96,900,000 |
| 1975-1980 Acquisitions | | | | | |
| DC-8 Replacements - 300 Aircraft | 8.0 | 566,667 | 2 | 2,060,000 | 170,000,000 |
| DC-9 Type - 150 Aircraft | 5.0 | 354,330 | 2 | 643,701 | 53,149,500 |
| Replacements - 100 Aircraft | 5.0 | 354,300 | 2 | 429,826 | 35,433,000 |
| Stretch Type - 60 Aircraft | 11.0 | 779,167 | 2 | 565,500 | 46,750,020 |
| Jumbo Type - 65 Aircraft | 22.8 | 1,615,000 | 2 | 1,272,050 | 104,975,000 |
| Net Investment - Flight Equipment (000) | | | | $6,959,264 | |
| Depreciation - Flight Equipment | | | | | $717,669,975 |

## ESTIMATED INVESTMENT BASE AND RETURN ON INVESTMENT
## DOMESTIC TRUNK CARRIERS

| | 1970 | 1975 | 1980 |
|---|---|---|---|
| Flight Equipment - Net | $4,411 831,000 | $5,155,844,000 | $6,959,264,000 |
| Ground and Other - Net (at 12% of Flight Equipment) | 529,419,723 | 618,701,280 | 835,111,680 |
| Working Capital (at 30 days' cash expenses) | 289,753,353 | 477,791,125 | 767,722,230 |
| Total Investment Base | $5,231,004,072 | $6,125,233,640 | $8,562,097,910 |
| Return Element at 10.5% | $ 549,255,427 | $ 643,149,532 | $ 899,020,280 |

## ESTIMATED CASH OPERATING COSTS AND WORKING CAPITAL REQUIREMENTS

## DOMESTIC TRUNK CARRIERS

| | 1970<br>Long Range Jets | <br>Short Range Jets | <br>Stretched Jets |
|---|---|---|---|
| Flying Operations - Crew | 37¢ | 37¢ | 39¢ |
| Fuel, Oil and Taxes | 47 | 33 | 54 |
| Insurance | 2.5 | 1.5 | 3 |
| Total per Aircraft Mile | 86.5¢ | 71.5¢ | 96¢ |
| Revenue Aircraft Miles (000) | 700,800 | 589,500 | 60,240 |
| Total | $606,192,000 | $421,492,500 | $ 57,830,400 |
| Total, All Aircraft | | | 1,084,514,900 |
| Maintenance - Labor | 13¢ | 9¢ | 15¢ |
| Materials | 22 | 16 | 25 |
| Burden | 22 | 15 | 25 |
| Total per Aircraft Mile | 57¢ | 40¢ | 65¢ |
| Revenue Aircraft Miles (000) | 700,800 | 589,500 | 60,240 |
| Total | $399,456,000 | $235,800,000 | $ 39,156,000 |
| Total, All Aircraft | | | $ 674,412,000 |
| Passenger Service: Revenue Passenger Miles (000,000) | | | 76,200 |
| Cost per Passenger Mile | | | .54¢ |
| Total | | | $ 411,480,000 |
| Aircraft & Traffic Servicing: Revenue Ton Miles - | | | |
| Passenger (000,000) | | | 6,858 |
| Cargo (000,000) | | | 1,930 |
| Total | | | 8,788 |
| Cost per Revenue Ton Mile | | | $ .096 |
| Total | | | $ 843,648,000 |
| Promotion & Sales: Gross Revenues (000) | | | $ 4,940,200 |
| Total Cost at 6% of Gross Revenues | | | $ 296,412,000 |
| General & Admin.: Total Costs, Excluding Depreciation | | | $3,311,466,900 |
| Total General & Admin. at 5% of Other Cash Costs | | | $ 165,573,345 |
| Total Cash Expenses | | | $3,477,040,245 |
| Working Capital at 30 Days' Cash Expenses | | | $ 289,753,353 |

| | 1975 | | | |
|---|---|---|---|---|
| | Long Range Jets | Short Range Jets | Stretched Jets | Jumbo Jets |
| Flying Operations - Crew | 43¢ | 43¢ | 45¢ | 48¢ |
| Fuel, Oil & Taxes | 51 | 35 | 58 | 96 |
| Insurance | 2.5 | 1.5 | 3 | 6.5 |
| Total per Aircraft Mile | 96.5¢ | 79.5¢ | 106¢ | 150¢ |
| Revenue Aircraft Miles (000) | 700,800 | 707,400 | 130,520 | 129,720 |
| Total | $676,272,000 | $562,383,000 | $138,351,200 | $ 194,580,000 |
| Total, All Aircraft | | | | $1,571,586,200 |
| Maintenance - Labor | 15¢ | 11¢ | 17¢ | 29¢ |
| Materials | 25 | 19 | 29 | 50 |
| Burden | 24 | 17 | 27 | 47 |
| Total per Aircraft Mile | 64¢ | 47¢ | 73¢ | 126¢ |
| Revenue Aircraft Miles (000) | 700,800 | 707,400 | 130,520 | 129,720 |
| Total | $448,512,000 | $332,478,000 | $ 95,279,600 | $ 163,447,200 |
| Total, All Aircraft | | | | $1,039,716,800 |
| Passenger Service: Revenue Passenger Miles (000,000) | | | | 116,200 |
| Cost per Passenger Mile | | | | .57¢ |
| Total | | | | $ 662,340,000 |
| Aircraft & Traffic Servicing: Revenue Ton Miles - Passenger (000,000) | | | | 11,039 |
| Cargo (000,000) | | | | 3,962 |
| Total | | | | $ 15,001 |
| Cost per Revenue Ton Mile | | | | $ .115 |
| Total | | | | $1,725,115,000 |
| Promotion & Sales: Gross Revenues (000) | | | | $ 7,695,200 |
| Total Cost at 6% of Gross Revenues | | | | $ 461,712,000 |
| General & Admin.: Total Costs, Excluding Depreciation | | | | $5,460,470,000 |
| Total General & Admin. at 5% of Other Cash Costs | | | | 273,023,500 |
| Total Cash Expenses | | | | $5,733,493,500 |
| Working Capital at 30 Days' Cash Expenses | | | | $ 477,791,125 |

## ESTIMATED CASH OPERATING COSTS AND WORKING CAPITAL REQUIREMENTS

## DOMESTIC TRUNK CARRIERS

|  | 1980 |  |  |  |
|---|---|---|---|---|
|  | Long Range Jets | Short Range Jets | Stretched Jets | Jumbo Jets |
| Flying Operations - Crew | 51¢ | 51¢ | 52¢ | 56¢ |
| Fuel, Cil & Taxes | 55 | 38 | 63 | 103 |
| Insurance | 2.5 | 1.5 | 3 | 6.5 |
| Total per Aircraft Miles | 108.5¢ | 90.5¢ | 118¢ | 165.5¢ |
| Revenue Aircraft Miles (000) | 700,800 | 384,212 | 250,937 | 270,214 |
| Total | $760,368,000 | $300,211,860 | $296,105,660 | $ 447,204,170 |
| Total, All Aircraft |  |  |  | $2,303,889,690 |
| Maintenance - Labor | 17¢ | 13¢ | 20¢ | 34¢ |
| Materials | 29 | 22 | 34 | 58 |
| Burden | 27 | 19 | 30 | 52 |
| Total per Aircraft Mile | 73¢ | 54¢ | 84¢ | 144¢ |
| Revenue Aircraft Miles (000) | 700,800 | 384,212 | 250,937 | 270,214 |
| Total | $511,584,000 | $477,474,480 | $210,787,080 | $ 389,108,160 |
| Total, All Aircraft |  |  |  | $1,588,953,720 |
| Passenger Service: Revenue Passenger Miles (000,000) |  |  |  | 168,400 |
| Cost per Passenger Mile |  |  |  | .61¢ |
| Total |  |  |  | $1,027,240,000 |
| Aircraft & Traffic Servicing: Revenue Ton Miles - Passenger (000,000) |  |  |  | 15,998 |
| Cargo (000,000) |  |  |  | 7,335 |
| Total |  |  |  | $ 23,333 |
| Cost per Revenue Ton Mile |  |  |  | $ .138 |
| Total |  |  |  | $3,219,954,000 |
| Promotion & Sales: Gross Revenues (000) |  |  |  | 11,398,850 |
| Total Cost at 6% of Gross Revenues |  |  |  | $ 683,931,000 |
| General & Admin.: Total Costs, Excluding Depreciation |  |  |  | $8,773,968,410 |
| Total General & Admin. at 5% of Other Cash Costs |  |  |  | 438,698,420 |
| Total Cash Expenses |  |  |  | $9,212,666,830 |

Working Capital at 30 Days!

## NOTES

Reference is made to previous Notes and Appendices for the bases of determining direct costs.

### Promotion and Sales

Although this cost could vary widely, and could increase rapidly through the effects of competition, the prevailing rule-of-thumb of approximately 6% of gross revenues is used throughout. The resulting sums should cover the sales mix of agency commissions, salary increases, and likely changes in advertising rates.

### General and Administrative

It is extremely difficult to predict the level of this cost. Managements may differ substantially in their interpretation of administrative requirements, and may through greater efficiency reduce personnel requirements, for example, by more effective procedures and techniques. On the other hand, inflationary factors are also at work. As a simple approximation, a device used by the C.A.B. in its analyses is here employed: this category of cost is estimated throughout at 5% of other cash costs.

APPENDIX 8G

## ESTIMATED PROFIT AND LOSS
## DOMESTIC TRUNK CARRIERS
($000)

| | 1970 | | 1975 | | 1980 | |
|---|---|---|---|---|---|---|
| **Revenue** | | | | | | |
| Passenger | $4,457,700 | | $6,704,700 | | $9,565,100 | |
| Cargo | 482,500 | | 990,500 | | 1,833,750 | |
| Total | | $4,940,200 | | $7,695,200 | | $11,398,850 |
| **Expenses** | | | | | | |
| Flying Operations | $1,085,515 | | $1,571,586 | | $2,303,890 | |
| Maintenance | 674,412 | | 1,039,717 | | 1,588,954 | |
| Depreciation | 418,272 | | 652,259 | | 717,670 | |
| Passenger Service | 411,480 | | 662,340 | | 1,027,240 | |
| Aircraft and Traffic Servicing | 843,648 | | 1,725,115 | | 3,219,954 | |
| Promotion & Sales | 296,412 | | 461,712 | | 683,931 | |
| General & Admin. | 165,573 | | 273,024 | | 438,598 | |
| Total Expenses | | $3,895,312 | | $6,385,753 | | $ 9,980,337 |
| Net Profit | | $1,044,888 | | $1,309,447 | | $ 1,418,513 |
| Federal Income Taxes at 48% | | 501,546 | | 628,535 | | 680,886 |
| Net Income | | $ 543,342 | | $ 680,912 | | $ 737,627 |

APPENDIX 9A

## FORECAST OF TRAFFIC, CAPACITY AND PASSENGER REVENUES
### International and Territorial Carriers

| | 1970 | 1975 | 1980 |
|---|---|---|---|
| Revenue Passenger Miles (millions) | 30,000 | 47,400 | 72,100 |
| Estimated Load Factor | 52% | 53% | 54% |
| Available Seat Miles Required (millions) | 58,820 | 89,430 | 133,520 |
| Offered Seat Miles (millions) | 58,845 | 88,372 | 135,413 |
| Computed Load Factor | 51.0% | 53.6% | 54.0% |
| Yield per Passenger Mile | 5.25¢ | 5.25¢ | 5.25¢ |
| Passenger Revenue (millions) | $1,575 | $2,489 | $3,785 |

## FORECAST OF CAPACITY REQUIREMENTS

## International and Territorial Carriers

| Aircraft Families | Utili-zation (Hours) | Average Speed (MPH) | Annual Hours Per Aircraft | Annual Miles Per Aircraft | Average Seating Capacity | Annual Available Seat Miles Per Aircraft (000) | Estimated Number of Aircraft | Total Annual Available Seat Miles (000,000) | Tota Annua Aircra Miles (000) |
|---|---|---|---|---|---|---|---|---|---|
| 1970 | | | | | | | | | |
| DC-8/B-707 | 10 | 480 | 3,650 | 1,752,000 | 120 | 210,240 | 220 | 46,253 | 385,4 |
| DC-8-60 Series | 11 | 500 | 4,015 | 1,825,000 | 230 | 419,750 | 30 | 12,592 | 54,7 |
| Total | | | | | | | | 58,845 | |
| 1975 | | | | | | | | | |
| DC-8/B-707 | 11 | 480 | 4,015 | 1,927,200 | 120 | 231,264 | 200 | 46,253 | 385,4 |
| DC-8-60 Series | 11 | 500 | 4,015 | 1,825,000 | 230 | 419,750 | 40 | 16,790 | 73,0 |
| B-747 | 11 | 515 | 4,015 | 2,067,725 | 350 | 723,704 | 35 | 25,329 | 72,3 |
| Total | | | | | | | | 88,372 | |
| 1980 | | | | | | | | | |
| DC-8/B-707 | 11 | 480 | 4,015 | 1,927,200 | 120 | 231,264 | 200 | 46,253 | 385,4 |
| DC-8-60 Series | 11 | 500 | 4,015 | 1,825,000 | 230 | 419,750 | 40 | 16,790 | 73, |
| B-747 | 11 | 515 | 4,015 | 2,067,725 | 350 | 723,704 | 100 | 72,370 | 206, |
| Total | | | | | | | | 135,413 | |

## ESTIMATE OF FLIGHT EQUIPMENT VALUE AND DEPRECIATION EXPENSE

### International and Territorial Carriers

| | Average Initial Price (millions) | Annual Depreciation per Unit | Average Years Depreciated by 1970 | Net Book Value 1970 (000) | Depreciation Expense 1970 |
|---|---|---|---|---|---|
| DC-8 Type<br>220 Aircraft | $ 8. | $ 566,667 | 5 | $1,136,666 | $124,666,740 |
| Stretch Type<br>30 Aircraft | 11. | 779,167 | 1 | 306,625 | 23,375,010 |
| **1970-1975 Acquisitions** | | | | | |
| DC-8 Replacements<br>50 Aircraft | 8. | 566,667 | | | |
| Stretch Type<br>10 Aircraft | 11. | 779,167 | | | |
| Jumbo Type<br>35 Aircraft | 22.8 | 1,615,000 | | | |
| **1975-1980 Acquisitions** | | | | | |
| DC-8 Replacements<br>150 Aircraft | 8. | 566,667 | | | |
| Jumbo Type<br>65 Aircraft | 22.8 | 1,615,000 | | | |
| Net Investment - Flight Equipment (000) | | | | $1,443,291 | |
| Depreciation - Flight Equipment | | | | | $148,041,750 |

## ESTIMATE OF FLIGHT EQUIPMENT VALUE AND DEPRECIATION EXPENSE

### International and Territorial Carriers

| | Average Initial Price (millions) | Annual Depreciation per Unit | Average Years Depreciated by 1975 | Net Book Value 1975 (000) | Depreciation Expense 1975 |
|---|---|---|---|---|---|
| DC-8 Type 220 Aircraft | $ 8. | $ 566,667 | 10 | $ 513,333 | $124,666,700 |
| Stretch Type 30 Aircraft | 11. | 779,167 | 6 | 189,750 | 23,375,010 |
| 1970-1975 Acquisitions | | | | | |
| DC-8 Replacements 50 Aircraft | 8. | 566,667 | 2 | 343,333 | 28,333,300 |
| Stretch Type 10 Aircraft | 11. | 779,167 | 2 | 94,417 | 7,791,670 |
| Jumbo Type 35 Aircraft | 22.8 | 1,615,000 | 2 | 684,950 | 56,525,000 |
| 1975-1980 Acquisitions | | | | | |
| DC-8 Replacements 150 Aircraft | 8. | 566,667 | | | |
| Jumbo Type 65 Aircraft | 22.8 | 1,615,000 | | | |
| Net Investment - Flight Equipment (000) | | | | $1,825,783 | |
| Depreciation - Flight Equipment | | | | | $240,691,680 |

## ESTIMATE OF FLIGHT EQUIPMENT VALUE AND DEPRECIATION EXPENSE

### International and Territorial Carriers

| | Average Initial Price (millions) | Annual Depreciation per Unit | Average Years Depreciated by 1980 | Net Book Value 1980 (000) | Depreciation Expense 1980 |
|---|---|---|---|---|---|
| DC-8 Type<br>220 Aircraft | $ 8. | $ 566,667 | Fully | $ 24,000 | 0 |
| Stretch Type<br>30 Aircraft | 11. | 779,167 | 11 | 72,875 | $ 23,375,010 |
| 1970-1975 Acquisitions | | | | | |
| DC-8 Replacements<br>50 Aircraft | 8. | 566,667 | 7 | 201,667 | 28,333,300 |
| Stretch Type<br>10 Aircraft | 11. | 779,167 | 7 | 55,458 | 7,791,670 |
| Jumbo Type<br>35 Aircraft | 22.8 | 1,615,000 | 7 | 402,325 | 56,525,000 |
| 1975-1980 Acquisitions | | | | | |
| DC-8 Replacements<br>[illegible] Aircraft | 8. | 566,667 | 2 | 1,020,000 | 85,000,000 |
| Jumbo Type<br>65 Aircraft | 22.8 | 1,615,000 | 2 | 1,272,050 | 104,975,000 |
| Net Investment -<br>Flight Equipment<br>(000) | | | | $3,058,375 | |
| Depreciation -<br>Flight Equipment | | | | | $305,999,980 |

## ESTIMATED INVESTMENT BASE AND RETURN ON INVESTMENT
### International and Territorial Carriers

| | 1970 | 1975 | 1980 |
|---|---|---|---|
| Flight Equipment - Net | $1,443,291,000 | $1,825,783,000 | $3,058,37 |
| Ground and Other - Net (at 12% of Flight Equipment) | 173,194,920 | 219,093,960 | 367,00 |
| Working Capital (30 Days' Cash Expenses) | 108,348,529 | 181,303,522 | 309,604 |
| Total | $1,724,834,449 | $2,226,180,482 | $3,734,98 |
| Return Element at 11% | $ 189,731,789 | $ 244,879,853 | $ 410,84 |

## ESTIMATED CASH OPERATING COSTS AND WORKING CAPITAL REQUIREMENTS

### International and Territorial Carriers

| | 1970 | |
|---|---|---|
| | Present Jets | Stretched Jets |
| Flying Operations - Crew | 37 | 39 |
| Fuel, Oil and Taxes | 47 | 54 |
| Insurance | 2.5 | 3 |
| Total per Aircraft Mile | 86.5¢ | 96¢ |
| Revenue Aircraft Miles (000) | 385,440 | 54,750 |
| Total | $333,405,600 | $ 52,560,000 |
| Total, All Aircraft | | $385,965,600 |
| Maintenance - Labor | 13¢ | 15¢ |
| Materials | 22 | 25 |
| Burden | 22 | 25 |
| Total per Aircraft Mile | 57¢ | 65¢ |
| Revenue Aircraft Miles (000) | 385,440 | 54,750 |
| Total | $219,700,800 | $ 35,587,500 |
| Total, All Aircraft | | $255,288,300 |
| Passenger Service: Revenue Passenger Miles (000,000) | | 30,000 |
| Cost per Passenger Mile | | .63¢ |
| Total | | $189,000,000 |
| Aircraft and Traffic Servicing: Revenue Ton Miles - | | |
| Passenger (000,000) | | 2,850 |
| Cargo (000,000) | | 1,245 |
| Total | | $ 4,095 |
| Cost per Revenue Ton Mile | | $ .072 |
| Total | | $294,840,000 |
| Promotion and Sales: Gross Revenues (000) | | $ 1,886,250 |
| Total Cost at 6% of Gross Revenues | | $113,175,000 |
| General and Administrative: Total Costs Excluding Depreciation | | $1,238,268,900 |
| Total General and Administrative at 5% of Other Cash Costs | | 61,913,445 |
| Total Cash Expenses | | $1,300,182,345 |
| Working Capital at 30 Days' Cash Expenses | | $ 108,348,529 |

## ESTIMATED CASH OPERATING COSTS AND WORKING CAPITAL REQUIREMENTS

### International and Territorial Carriers

| | 1975 Present Jets | 1975 Stretched Jets | 1975 Jumbo Jets |
|---|---|---|---|
| Flying Operations - Crew | 43¢ | 45¢ | 48¢ |
| Fuel, Oil and Taxes | 51 | 58 | 96 |
| Insurance | 2.5 | 3 | 6.5 |
| Total per Aircraft Mile | 96.5¢ | 106¢ | 150.5¢ |
| Revenue Aircraft Miles (000) | 385,440 | 73,000 | 72,370 |
| Total | $371,949,600 | $ 77,380,000 | $ 108,916,850 |
| Total, All Aircraft | | | $ 558,246,450 |
| Maintenance - Labor | 15¢ | 17¢ | 29¢ |
| Materials | 25 | 29 | 50 |
| Burden | 24 | 27 | 47 |
| Total per Aircraft Mile | 64¢ | 73¢ | 126¢ |
| Revenue Aircraft Miles (000) | 385,440 | 73,000 | 72,370 |
| Total | $246,681,600 | $ 53,290,000 | $ 91,186,200 |
| Total, All Aircraft | | | $ 391,157,800 |
| Passenger Service: Revenue Passenger Miles (000,000) | | | 47,400 |
| Cost per Passenger Mile | | | .67¢ |
| Total | | | $ 317,580,000 |
| Aircraft and Traffic Servicing: Revenue Ton Miles - Passenger (000,000) | | | 4,503 |
| Cargo | | | 2,658 |
| Total | | | 7,161 |
| Cost per Revenue Ton Mile | | | $ .086 |
| Total | | | $ 615,846,000 |
| Promotion and Sales: Gross Revenues (000) | | | $ 3,153,500 |
| Total Cost at 6% of Gross Revenues | | | $ 189,210,000 |
| General and Administrative: Total Costs Excluding Depreciation | | | $2,072,040,250 |
| Total General and Administrative at 5% of Other Cash Costs | | | $ 103,602,012 |
| Total Cash Expenses | | | $2,175,642,262 |
| Working Capital at 30 Days' Cash Expenses | | | $ 181,303,522 |

## International and Territorial Carriers

| | 1980 Present Jets | 1980 Stretched Jets | 1980 Jumbo Jets |
|---|---|---|---|
| Flying Operations - Crew | 51¢ | 52¢ | 56¢ |
| Fuel, Oil and Taxes | 55 | 63 | 103 |
| Insurance | 2.5 | 3 | 6.5 |
| Total per Aircraft Mile | 108.5¢ | 118¢ | 165.5¢ |
| Revenue Aircraft Miles (000) | 385,440 | 73,000 | 206,773 |
| Total | $418,202,400 | $ 86,140,000 | $ 342,209,315 |
| Total, All Aircraft | | | $ 846,551,715 |
| Maintenance - Labor | 17¢ | 20¢ | 34¢ |
| Materials | 29 | 34 | 58 |
| Burden | 27 | 30 | 52 |
| Total per Aircraft Mile | 73¢ | 84¢ | 144¢ |
| Revenue Aircraft Miles (000) | 385,440 | 73,000 | 206,773 |
| Total | $281,371,200 | $ 61,320,000 | $ 297,753,120 |
| Total, All Aircraft | | | $ 640,444,320 |
| Passenger Service: Revenue Passenger Miles (000,000) | | | 72,100 |
| Cost per Passenger Mile | | | .70¢ |
| Total | | | $ 504,700,000 |
| Aircraft and Traffic Servicing: Revenue Ton Miles - Passenger (000,000) | | | 6,895 |
| Cargo (000,000) | | | 5,164 |
| Total | | | 12,059 |
| Cost per Revenue Ton Mile | | | $ .103 |
| Total | | | $1,242,077,000 |
| Promotion and Sales: Gross Revenues (000) | | | $ 5,076,000 |
| Total Cost at 6% of Gross Revenues | | | $ 304,560,000 |
| General and Administrative: Total Costs Excluding Depreciation | | | $3,538,333,035 |
| Total General and Administrative at 5% of Other Cash Costs | | | $ 176,916,651 |
| Total Cash Expense | | | $3,715,249,686 |
| Working Capital at 30 Days' Cash Expenses | | | $ 309,604,140 |

## ESTIMATED PROFIT AND LOSS

### International and Territorial Carriers

### (000)

| | 1970 | | 1975 | | 1980 | |
|---|---|---|---|---|---|---|
| **Revenue** | | | | | | |
| Passenger | $1,575,000 | | $2,489,000 | | $3,785,000 | |
| Cargo | 311,250 | | 664,500 | | 1,291,000 | |
| Total Revenue | | $1,886,250 | | $3,153,500 | | $5,076,0 |
| **Expenses** | | | | | | |
| Flying Operations | $ 385,966 | | $ 558,246 | | $ 846,552 | |
| Maintenance | 255,288 | | 391,158 | | 640,444 | |
| Depreciation | 148,042 | | 240,692 | | 306,000 | |
| Passenger Service | 189,000 | | 317,580 | | 504,700 | |
| Aircraft and Traffic Servicing | 294,840 | | 615,846 | | 1,242,077 | |
| Promotion and Sales | 113,175 | | 189,210 | | 304,560 | |
| General & Administrative | 61,913 | | 103,602 | | 176,917 | |
| Total Expensss | | $1,448,224 | | $2,416,334 | | $4,021,2 |
| Net Profit | | $ 438,026 | | $ 737,166 | | $1,055,7 |
| Federal Income Taxes at 48% | | $ 210,252 | | $ 353,840 | | $ 506,7 |
| Net Income | | $ 227,774 | | $ 383,326 | | $ 548,9 |

APPENDIX 10A

## FORECAST OF TRAFFIC, CAPACITY AND PASSENGER REVENUES
### Local Service Carriers

| | 1970 | 1975 | 1980 |
|---|---|---|---|
| Revenue Passenger Miles (millions) | 5,792 | 12,800 | 28,288 |
| Estimated Load Factor | 48% | 51% | 53% |
| Available Seat Miles Required (millions) | 12,066 | 25,100 | 53,370 |
| Offered Seat Miles (millions) | 12,030 | 25,098 | 53,374 |
| Computed Load Factor | 48.1% | 51.0% | 53.0% |
| Yield per Passenger Mile | 7.5¢ | 7.5¢ | 7.5¢ |
| Passenger Revenue (thousands) | $434,400 | $960,000 | $2,121,600 |

## FORECAST OF CAPACITY REQUIREMENTS

### Local Service Carriers

| Aircraft Families | Daily Utili-zation (Hours) | Average Speed (MPH) | Annual Hours per Aircraft | Annual Miles per Aircraft | Average Seating Capacity | Annual Available Seat Miles per Aircraft (000) | Est. Number of Air-craft | Total Annual Available Seat Miles (000,000) | Total Annual Aircraf Miles (000) |
|---|---|---|---|---|---|---|---|---|---|
| 1970 | | | | | | | | | |
| Jet (DC-9,B-727,etc.) | 7 | 370 | 2,555 | 945,350 | 80 | 75,628 | 100 | 7,563 | 94,53 |
| Turbo-Prop (CV-600, F-27, etc.) | 6 | 200 | 2,190 | 438,000 | 50 | 21,900 | 150 | 3,285 | 65,70 |
| Piston (CV-240, etc.) | 6 | 150 | 2,190 | 328,500 | 40 | 13,140 | 90 | 1,182 | 29,56 |
| Total | | | | | | | | 12,030 | |
| 1975 | | | | | | | | | |
| Jet | 8 | 370 | 2,920 | 1,080,400 | 85 | 91,834 | 240 | 21,813 | 259,29 |
| Turbo-Prop | 6 | 200 | 2,190 | 438,000 | 50 | 21,900 | 150 | 3,285 | 65,70 |
| Total | | | | | | | | 25,098 | |
| 1980 | | | | | | | | | |
| Jet | 8 | 370 | 2,920 | 1,080,400 | 85 | 91,834 | 545 | 50,089 | 588,81 |
| Turbo-Prop | 6 | 200 | 2,190 | 438,000 | 50 | 21,900 | 150 | 3,285 | 65,70 |
| Tota | | | | | | | | 53,374 | |

## ESTIMATE OF FLIGHT EQUIPMENT VALUE AND DEPRECIATION EXPENSE

### Local Service Carriers

| | Average Initial Price | Annual Depreciation | Average Years Depreciated By 1970 | Net Book Value 1970 | Depreciatio Expense 1970 |
|---|---|---|---|---|---|
| Piston Equipment (Estimated at $30,000 Residual - 90 Aircraft) | | | Fully | $ 2,700,000 | 0 |
| Turbo-Prop Equipment - 10 Year Life, 15% Residual | $1,000,000 | $ 85,000 | 4 | | |
| Fleet - 150 Aircraft | | | | 99,000,000 | $12,750,000 |
| Jet Acquisition, 1965-1970 12 Year Life, 15% Residual | $4,750,000 | $336,460 | 2 | | |
| Fleet - 100 Aircraft | | | | 407,708,000 | 33,646,000 |
| Jet Acquisitions, 1970-1975 12 Year Life, 15% Residual | $5,000,000 | $354,330 | | | |
| Fleet - 140 Aircraft | | | | | |
| Jet Acquisitions, 1975-1980 12 Year Life, 15% Residual | $5,000,000 | $354,330 | | | |
| Fleet - 305 Aircraft | | | | | |
| Net Investment - Flight Equipment | | | | $509,408,000 | |
| Depreciation - Flight Equipment | | | | | $46.306,000 |

## ESTIMATE OF FLIGHT EQUIPMENT VALUE AND DEPRECIATION EXPENSE

### Local Service Carriers

| | Average Initial Price | Annual Depreciation | Average Years Depreciated By 1975 | Net Book Value 1975 | Depreciati Expense 1975 |
|---|---|---|---|---|---|
| Piston Equipment (Estimated at $30,000 Residual - 90 Aircraft | | | | | |
| Turbo-Prop Equipment - 10 Year Life, 15% Residual | $1,000,000 | $ 85,000 | 9 | 0 | |
| Fleet - 150 Aircraft | | | | $ 35,250,000 | $12,750,00 |
| Jet Acquisitions, 1965-1970 12 Year Life, 15% Residual | $4,750,000 | $336,460 | 7 | | |
| Fleet - 100 Aircraft | | | | 239,478,000 | 33,646,0C |
| Jet Acquisitions, 1970-1975 12 Year Life, 15% Residual | $5,000,000 | $354,330 | 2 | | |
| Fleet - 140 Aircraft | | | | 600,787,600 | 49,606,2C |
| Jet Acquisitions, 1975-1980 12 Year Life, 15% Residual | $5,000,000 | $354,330 | | | |
| Fleet 305 Aircraft | | | | | |
| Net Investment - Flight Equipment | | | | $875,515,600 | |
| Depreciation - Flight Equipment | | | | | $96,002,2 |

## ESTIMATE OF FLIGHT EQUIPMENT VALUE AND DEPRECIATION EXPENSE

### Local Service Carriers

| | Average Initial Price | Annual Depreciation | Average Years Depreciated By 1980 | Net Book Value 1980 | Depreciat Expense 1980 |
|---|---|---|---|---|---|
| Piston Equipment (Estimated at $30,000 Residual - 90 Aircraft) | | | | | |
| Turbo-Prop Equipment - 10 Year Life, 15% Residual | $1,000,000 | $ 85,000 | Fully | 0 | |
| Fleet - 150 Aircraft | | | | $ 22,500,000 | |
| Jet Acquisitions, 1965-1970 12 Year Life, 15% Residual | $4,750,000 | $336,460 | Fully | | |
| Fleet - 100 Aircraft | | | | 71,250,000 | |
| Jet Acquisitions, 1970-1975 12 Year Life, 15% Residual | $5,000,000 | $354,330 | 7 | | |
| Fleet - 140 Aircraft | | | | 352,756,600 | 49,606, |
| Jet Acquisitions, 1975-1980 12 Year Life, 15% Residual | $5,000,000 | $354,330 | | | |
| Fleet - 305 Aircraft | | | 2 | 1,308,858,700 | 108,061, |
| Net Investment - Flight Equipment | | | | $1,755,365,300 | |
| Depreciation - Flight Equipment | | | | | $157,667, |

## ESTIMATED INVESTMENT BASE

### Local Service Carriers

| | 1970 | 1975 | 1980 |
|---|---|---|---|
| Flight Equipment - Net | $509,408,000 | $ 875,516,600 | $2,013,830, |
| Ground and Other - Net (at 12% of Flight Equipment | 61,128,960 | 105,061,992 | 241,659, |
| Working Capital (30 Days' Cash Expenses) | 30,449,094 | 65,084,493 | 149,002, |
| Total | $600,986,054 | $1,045,663,085 | $2,404,492, |

## ESTIMATED CASH OPERATING COSTS AND WORKING CAPITAL REQUIREMENTS

### Local Service Carriers

| | 1970 | | |
|---|---|---|---|
| | Piston | Turbo-Prop | Jet |
| Flying Operations - Crew | 26¢ | 22¢ | 37¢ |
| Fuel, Oil and Taxes | 20 | 17 | 33 |
| Insurance | 1.25 | 1.5 | 1.5 |
| Total per Aircraft Mile | 47.25¢ | 40.5¢ | 71.5¢ |
| Revenue Aircraft Miles (000) | 29,565 | 65,700 | 94,535 |
| Total | $13,969,500 | $26,608,500 | $ 67,592,500 |
| Total, All Aircraft | | | $108,170,500 |
| Maintenance - Labor | | | 9¢ |
| Materials | 30¢ | 23¢ | 16 |
| Burden | 13 | 16 | 15 |
| Total per Aircraft Mile | 43¢ | 39¢ | 40¢ |
| Revenue Aircraft Miles (000) | 29,565 | 65,700 | 94,535 |
| Total | $12,712,950 | $25,623,000 | $ 37,814,000 |
| Total, All Aircraft | | | $ 76,149,950 |
| Passenger Service-Revenue Passenger Miles (000,000) | | | 5,792 |
| Cost per Passenger Mile | | | .53¢ |
| Total | | | $ 30,697,600 |
| Aircraft & Traffic Servicing: Revenue Ton Miles - Passenger (000,000) | | | 550.2 |
| Cargo (000,000) | | | 73.0 |
| Total (000,000) | | | 623.2 |
| Cost per Revenue Ton Mile | | | 17¢ |
| Total | | | $105,944,000 |
| Promotion & Sales: Gross Revenues (000) | | | $ 450,460 |
| Total Cost at 6% of Gross Revenues | | | $ 27,027,600 |
| General & Administrative: Total Costs, Excluding Depreciation | | | $347,989,650 |
| Total General & Administrative at 5% of Other Cash Costs | | | 17,399,483 |
| Total Cash Expenses | | | $365,389,133 |
| 30 Days' Cash Expenses - Working Capital | | | $ 30,449,094 |

APPENDIX 10E
Page 2 of 3

## ESTIMATED CASH OPERATING COSTS AND WORKING CAPITAL REQUIREMENTS

### Local Service Carriers

| | 1975 | |
|---|---|---|
| | Turbo-Prop | Jet |
| Flying Operations - Crew | 26¢ | 43¢ |
| Fuel, Oil and Taxes | 18 | 35 |
| Insurance | 1.5 | 1.5 |
| Total per Aircraft Mile | 45.5¢ | 79.5¢ |
| Revenue Aircraft Miles (000) | 65,700 | 259,296 |
| Total | $29,893,500 | $206,140,320 |
| Total, All Aircraft | | $236,033, 20 |
| Maintenance - Labor ) Materials) | 27¢ | 11¢ |
| Burden | 18 | 19 |
| | | 17 |
| Total per Aircraft Mile | 45¢ | 47¢ |
| Revenue Aircraft Miles (000) | 65,700 | 259,296 |
| Total | $29,565,000 | $121,869,120 |
| Total, All Aircraft | | $151,434,120 |
| Passenger Service: Revenue Passenger Miles (000,000) | | 12,800 |
| Cost per Passenger Mile | | .56¢ |
| Total | | $ 71,680,000 |
| Aircraft & Traffic Servicing: Revenue Ton Miles - | | |
| Passenger (000,000) | | 1,216.0 |
| Cargo (000,000) | | 191.6 |
| Total (000,000) | | 1,407.6 |
| Cost per Revenue Ton Mile | | 16¢ |
| Total | | $225,216,000 |
| Promotion & Sales: Gross Revenues (000) | | $ 1,002,152 |
| Total Cost at 6% of Gross Revenues | | $ 60,129,120 |
| General & Administrative: Total Costs, Excluding Depreciation | | $744,493,060 |
| Total General & Administrative at 5% of Other Cash Costs | | 36,520,853 |
| Total Cash Expenses | | $781,013,913 |
| 30 Days' Cash Expenses - Working Capital | | $ 65,084,493 |

# ESTIMATED CASH OPERATING COSTS AND WORKING CAPITAL REQUIREMENTS

## Local Service Carriers

| | 1980 | |
|---|---|---|
| | Turbo-Prop | Jet |
| Flying Operations - Crew | 31¢ | 51¢ |
| Fuel, Oil and Taxes | 20 | 38 |
| Insurance | 1.5 | 1.5 |
| Total per Aircraft Mile | 52.5% | 90.5¢ |
| Revenue Aircraft Miles (000) | 65,700 | 588,818 |
| Total | $34,492,500 | $532,880,290 |
| Total, All Aircraft | | $567,372,790 |
| Maintenance - Labor<br>Materials | 31¢ | 13¢<br>22 |
| Burden | 20 | 19 |
| Total per Aircraft Mile | 51¢ | 54¢ |
| Revenue Aircraft Miles (000) | 65,700 | 588,818 |
| Total | $33,507,000 | $317,961,720 |
| Total, All Aircraft | | $351,468,720 |
| Passenger Service: Revenue Passenger Miles (000,000) | | 28,288 |
| Cost per Passenger Mile | | .58¢ |
| Total | | $164,070,400 |
| Aircraft & Traffic Servicing: Revenue Ton Miles - | | |
| Passenger (000,000) | | 2,737.4 |
| Cargo (000,000) | | 502.9 |
| Total (000,000) | | 3,240.3 |
| Cost per Revenue Ton Mile | | 15¢ |
| Total | | $486,045,000 |
| Promotion & Sales: Gross Revenues (000) | | $ 2,232,238 |
| Total Cost at 6% of Gross Revenues | | $133,934,280 |
| General & Administrative: Total Costs, Excluding Depreciation | | $1,702,891,190 |
| Total General & Administrative at 5% of Other Cash Costs | | 85,144,560 |
| Total Cash Expenses | | $1,788,035,750 |
| 30 Cays' Cash Expenses - Working Capital | | $ 149,002,980 |

APPENDIX 10F

## ESTIMATED PROFIT AND LOSS
## Local Service Carriers
(000)

| | 1970 | | 1975 | | 1980 | |
|---|---|---|---|---|---|---|
| **Revenue** | | | | | | |
| Passenger | $434,400 | | $960,000 | | $2,121,600 | |
| Cargo | 16,060 | | 42,152 | | 110,638 | |
| Total Revenues | | $450,460 | | $1,002,152 | | $2,232,238 |
| **Expenses** | | | | | | |
| Flying Operations | $108,171 | | $236,034 | | $ 567,373 | |
| Maintenance | 76,150 | | 151,434 | | 351,469 | |
| Depreciation | 46,396 | | 96,002 | | 157,668 | |
| Passenger Service | 30,698 | | 71,680 | | 164,070 | |
| Aircraft & Traffic Servicing | 105,944 | | 225,216 | | 486,045 | |
| Promotion & Sales | 27,028 | | 60,129 | | 133,934 | |
| General & Administrative | 17,399 | | 36,521 | | 85,145 | |
| Total Expenses | | $411,786 | | $ 877,016 | | $1,945,704 |
| Net Operating Profit Before Subsidy | | $ 38,674 | | $ 125,136 | | $ 286,534 |

APPENDIX 11A

## [illegible] AND INVESTMENT

## All-Cargo Services

| | 1970 | 1975 | 1980 |
|---|---|---|---|
| Revenue Ton-Miles - Domestic (millions) | 1,931 | 3,962 | 7,335 |
| - International (millions) | 1,245 | 2,659 | 5,164 |
| Total | 3,176 | 6,621 | 12,499 |
| Estimated Load Factor | 70% | 70% | 70% |
| Average Aircraft Capacity (tons) | 40 | 40 | 40 |
| Revenue tons at 70% Load Factor | 28 | 28 | 28 |
| Average Daily Aircraft Utilization (hours) | 9 | 9 | 9 |
| Average Speed (MPH) | 480 | 480 | 480 |
| Revenue Ton Miles per Year per Aircraft | 44,150,400 | 44,150,400 | 44,150,400 |
| Number of Aircraft Required | 72 | 150 | 285 |
| Depreciation Annually per Aircraft | $566,667 | $566,667 | $566,667 |
| Total Annual Depreciation (000) | $ 40,800 | $ 85,000 | $161,500 |
| Annual Aircraft Miles (000) | 113,537 | 236,520 | 449,388 |
| Investment (000) | | | |
| Aircraft, Average 50% Depreciated | $331,200 | $690,000 | $1,311,000 |
| Ground and Other at 12% of Aircraft | 39,744 | 82,800 | 157,320 |
| Working Capital (Appendix III-F-2) | 36,544 | 76,679 | 159,080 |
| Total | $407,488 | $851,479 | $1,627,400 |
| Return Element at 10.5% (000) | $ 42,786 | $ 89,405 | $ 170,877 |
| Estimated Yield per Revenue Ton Mile | 17¢ | 17¢ | 17¢ |
| Gross Revenue (000) | $539,920 | $1,125,750 | $2,124,830 |

NOTES: For purposes of simplicity, this analysis assumes that all-cargo services will be performed as an add-on to combination service, and will be operated by either combination carriers or by the certificated all-cargo carriers such as Flying Tiger and Seaboard World. The combined result of such operations, both domestic and international, is shown in this and the following Appendix 11B.

APPENDIX 11B

## ESTIMATED PROFIT AND LOSS
### All-Cargo Services

| | 1970 | 1975 | 1980 |
|---|---|---|---|
| Revenue Aircraft Miles (000) | $ 113,537 | $ 236,520 | $ 449,388 |
| Revenue Ton Miles (000,000) | 3,176 | 6,621 | 12,499 |
| Gross Revenue | $ 539,920 | $ 1,125,570 | $ 2,124,830 |
| Expenses: | | | |
| Flying Operations | $ 98,210 | $ 228,242 | $ 487,586 |
| Maintenance | 64,716 | 151,373 | 328,053 |
| Depreciation | 40,800 | 85,000 | 161,500 |
| Aircraft and Traffic Servicing | 222,320 | 463,470 | 874,930 |
| Promotion and Sales | 32,395 | 67,534 | 127,490 |
| General and Administrative | 20,882 | 45,531 | 90,903 |
| Total Expenses | $ 479,323 | $ 1,041,150 | $ 2,070,462 |
| Net Profit | $ 60,597 | $ 84,420 | $ 54,368 |
| Federal Income Tax at 48% | 29,087 | 52,160 | 26,097 |
| Net Income | $ 31,510 | $ 32,260 | $ 28,271 |
| Working Capital (30 Days' Cash Expenses) | $36,543,580 | $79,679,167 | $159,080,167 |